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NUCLEAR SCIENCE ABSTRACTS

Volume 2 Number 7

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ABSORPTION AND SCATTERING OF RADIATION

1306 Range of Np^{237} Alpha Particles in Air by T J La Chapelle. AECD-2496 (ANL-JJK-14B-78) Sept 24 1947 Decl Mar 3 1949 16p For publication in NNES

The mean range of alpha particles from Np^{237} is reported to be 3.22 ± 0.02 cm in dry air at 150°C and 760 mm mercury pressure, using 3.68 cm for the comparative range of the Pu^{239} alpha particle. The corresponding energy of the neptunium radiation is 4.72 ± 0.02 Mev. The present measurements have eliminated errors due to thick samples and contamination by other alpha radiation. The paper represents a complete revision of an earlier interpretation of the data, and is based on the method of least squares. 27 references.

1307 Absorption of X-Rays in Air by Frank H Day and Lauriston S Taylor Radiology 52 239-247 (1949) Feb (See also Nuclear Science Abstract No. I-217)

Tabulated data have been taken on the air-absorption of x-rays which are suitable for obtaining the necessary air-absorption corrections for beryllium-window x-ray tubes (with their high-intensity output of soft x-rays) where distance is a factor in the x-ray exposure. Curves and tabulated data for the linear absorption coefficients for air under atmospheric conditions are given for x-ray voltages ranging from 7.5 to 200 kv. The data were obtained for beryllium-window x-ray tubes and for added filtration of 0.05 to 6.0 mm of Al in addition to minimum filtration of 1.5 mm of Be (or 1.29 mm of cerium glass) plus 119 cm of air. A comparison is also made between absorption data taken using a thimble ionization chamber and data obtained using a free-air ionization chamber.

1308 Meson Bremsstrahlung by Deuterons by D I Blokhintsev Doklady Akad Nauk SSSR 61 811-814 (1948) Aug 11 (In Russian)

A computation is made of the meson radiation taking place at a collision of a deuteron with a nucleon, in a case when the energy of each nucleon of the deuteron is not sufficient for the production of a meson. Under the assumption that the deuteron does not disintegrate at the collision, the total effective cross section of the meson radiation is found to be equal to about 10^{-30} cm^2 for an initial state energy 200 Mev. The value would be larger if the dissociation of the deuteron was taken into account.

ATOMIC BOMBS AND WARFARE

1309 Atomic Warfare and the Veterinary Profession by Wayne O Kester and Everett B Miller J Amer Vet Med Assoc 114 113-119 (1949) March

The veterinarian with his knowledge of the effect of x-ray burn, and blast injury is basically trained and experienced to grasp the full significance and limitations of atomic warfare. It is evident also that, in event of atomic warfare, the veterinary profession will constitute one of the Nation's bulwarks--both in its traditional role of safeguarding the livestock and food-producing industries and in the public health field of conserving and safeguarding existing food supplies. The veterinarian does not have to be a specialist, but he should devote a few moments to the study of atomic warfare in its relation to animals, to food, and related industries, as well as to the veterinary service in his locality. There is need for each veterinarian to give the matter continuing thought as it may affect his own activity, and there is great need for further research in an effort to solve the many serious problems yet unanswered.

1310 Detonation Wave in Nuclear Explosions by P Caldirola Nuovo Cimento 5 509-510 (1948) Oct (In Italian) (Letter to the editor) (See also Nuclear Science Abstract No. I-732)

The hydro-thermodynamic theory of the detonation (Paterson, Research 1 221 (1948)) is applied to the case of the explosive chain fission of metallic uranium. The extremely high temperature of the reaction necessitates the introduction of the radiation energy and the radiation pressure into the equations. The following numerical values (per unit mass) are obtained: $p \cong 9.0 \times 10^{12}$ Kg/cm^2 (pressure of the explosion products); $T \cong 2.4 \times 10^8$ °K (temperature); $D \cong 3.3 \times 10^7$ cm/sec (velocity of the detonation wave); $W \cong 1.4 \times 10^7$ cm/sec (displacement velocity of the explosion products.) The value

ATOMIC BOMBS AND WARFARE (continued)

of the wave velocity D is considerably smaller than the mean velocity U = 2.10^8 cm/sec of neutrons in thermal equilibrium of the found temperature T. The relation between D and U is, of course, determined by the kinetics of the chain reaction.

1311 The Medical Aspects of the Atomic Bomb by W B Looney Virginia Med Monthly 76 73-75 (1949) Feb

This review is based on material in the course on Medical Aspects of Radioactivity given by the Medical Department, U. S. Navy, and the American College of Physicians at the Naval Medical Research Center, Bethesda, Md., from February 18 to 18, 1948.

ATOMIC POWER AND PILES

1312 Atomic Energy and Its Liberation by Y I Frenkel. Priroda No. 5 7-23 (1946) (Original in Russian; English translation is NP-577)

A general discussion of atomic structure and the relase of nuclear energy by various mechanisms is given. Topics discussed include: 1. Transmutation of Hydrogen into Heavy Elements. (Prout's hypothesis and isotopes, liberation of energy in the process of transmutation of hydrogen into heavier elements, and the energy of activation and transmutation of hydrogen in stars). 2. The Structure of Complex Atoms and Their Splitting into Simple Ones. (Structure of the hydrogen atom (protium), structure of heavier atoms and complex atomic nuclei, conversion of protons and neutrons into each other within complex nuclei, and the nature and character of nuclear forces). 3. Technical Utilization of Atomic Energy. (The fission of actinouranium by chain reaction and multiplication of free neutrons, uranium piles and the production of plutonium, and possibility of thermal explosion of relatively stable elements.

1313 The Control Panel by Maurice Suedin Atomes 4 47-48 (1949) Feb (In French)

The control panel is used for starting, stopping, and regulating the power of an atomic pile; here are located the instruments which, for safety and health reasons, are necessary for controlling the radiation intensity in the vicinity of the pile. By means of the control panel, bars of cadmium or boron can be raised or lowered within the pile thus controlling the neutron flux. Ionization chambers are used to measure the intensity of radiation within the pile. The techniques for starting and stopping the operation of the pile are outlined.

1314 The First French Atomic Pile by Frederic Joliot-Curie Atomes 4 39-40 (1949) Feb (In French)

The preliminary activities which resulted in the construction of this first French atomic pile, a low power uranium oxide-heavy water pile, are reviewed. Plans for the construction of two more piles are outlined. Three principle future objectives in the French atomic energy program are: (1) Production of artificial radioisotopes necessary in modern industrial and biological research with the pile now in operation; training technical personnel and developing plans for a medium power pile. (2) The construction and equipment of a center for nuclear studies at Saclay where scientific and technical work can be carried on in proximity to the new pile and large particle accelerators. (3) Development of a program for uranium ore prospecting in France and its overseas territory in order to assure the development of atomic energy in France.

1315 The Manufacture of Billets of Uranium Oxide by J A Stohr Atomes 4 57-58 (1949) Feb (In French)

The billets for the French pile are constructed of aluminium tubes filled with brown UO_2 obtained by the reduction of UO_3 in a stream of hydrogen. The density of the brown powder is increased by using a press and a mold to a specific gravity of approximately 6. The density of the compressed pieces are further increased by a fritting process which in brief consists of heating them to high temperature (around 1600°C) in an atmosphere of hydrogen and nitrogen until a specific gravity of approximately 10 is reached.

ATOMIC POWER AND PILES (continued)

1316 The Mechanics of the Pile by Eugene Le Meur Atomes 4 43-45 (1949) Feb (In French)

The principles of energy production in an atomic pile and the conversion of this energy to useful work is discussed; the principles of construction of the French low-power uranium oxide - heavy water pile is outlined. A schematic drawing of the pile is given.

1317 The Problem of Supply by R Echard Atomes 4 58 (1949) Feb (In French)

The securing of the materials necessary for the construction of the French pile is briefly discussed.

1318 Use and Operation of the Chatillon Pile by Andre Ertaud. Atomes 4 49-51 (1949) Feb (In French)

Fundamental concepts regarding the fission of uranium by neutrons, and the conditions necessary for a chain reaction based on the critical masses needed to maintain a neutron reproduction coefficient greater than unity are reviewed. The part play by the neutron reflector in a pile assembly, and the radiation hazards accompanying a functioning pile are mentioned. The pile production of radioisotopes for use in tracer studies is briefly discussed.

BIOLOGICAL EFFECTS OF RADIATION

1319 Changes in the Water Content and Distribution in Rats and Mice after Chronic and Acute Total-Body X Irradiation by Owen France. AECU-131 (CH-3889) June 1946 34p

In order to determine something of the nature of the changes in water metabolism that occur after total-body irradiation, studies were made of the relative water contents of muscle, plasma, and the entire carcass of rats and mice. Water distribution, as measured by the volume of distribution of injected thiocyanate ion and of intravenously-administered blue dye, T1824, was used as an estimate of changes in the extracellular and vascular compartments, respectively. A transient increase in thiocyanate space occurred in rats at an x-ray dosage that was about 15 per cent of the LD_{50}. A similar increase was observed in the total-body water of mice that was about 30 per cent of the LD_{50}. No changes occurred in relative muscle or plasma water, or in plasma volume, until the lethal levels of x-irradiation were approached, at which time increases were observed in all 5 types of measurements. The increases occurred in at least some cases in the terminal period, and in the presence of a negative water balance.

Chronic irradiation with x-rays and with α-rays from injected plutonium resulted in a state of relative hydration. The thiocyanate space, again, was the most sensitive indicator of change in water metabolism, although some increases in plasma and muscle water did result from the higher dosages. By means of studying the effects of pre- and post-irradiation water restriction on the survival time of rats and mice, it was determined that the dehydration resulting from this procedure was apparently helpful in that the irradiated animals so treated lived longer than the x-irradiated controls.

1320 The Effect of Massive Whole Body X-ray on the Antibody Content of Lymph, p 166-169 in "The Lymphocyte Studies on Its Relationship to Immunologic Processes in the Cat" by Charles G Craddock Jr, William N Valentine and John S Lawrence J Lab and Clin Med 34 158-177 (1949) Feb

Lymph specimens were collected every 2 hours for 8 hours following irradiation by a single total body dose of 1500 r. In spite of widespread destruction of lymphoid cells, no appreciable alteration in antibody concentration of the lymph was detected. No consistent correlation was found to exist between the height of the serum antibody titer and that of the lymph. Thus, in several instances no antibody could be detected in the lymph, in spite of a significant serum antibody titer. The concentration of serum antibody at the end of the experiment was higher than that of the lymph in all cases except one.

BIOLOGICAL EFFECTS OF RADIATION (continued)

1321 Effect of Roentgen Irradiation on the Gastric Mucosa by Wm E Ricketts, Joseph B Kirsner, Eleanor M Humphreys and Walter Lincoln Palmer Gastroenterology 11 818-832 (1948) Dec

Moderate roentgen irradiation (1100 to 2500 r, applied in divided doses) of the fundus and body of the stomach in man produces an acute transitory, symptomless gastritis that is characterized gastroscopically by hyperemia, hemorrhage, edema, and adherent exudate, and histologically by degenerative changes in the epithelial cells and lymph follicles, increased cellular infiltration, and relatively minor changes in the blood vessels. Atrophy of the gastric mucosa often ensues; it is uniformly present in patients with prolonged post-radiation anacidity. 9 figures and 40 references.

1322 Foam Cell Plaques in Intima of Myometrial Arteries: A Presumptive Sign of Previous Irradiation by John F Sheehan Amer J Clin Path 19 30-34 (1949) Jan

That the foam cell intimal plaque by itself is a strongly presumptive sign of previous radium and roentgen irradiation, in the human uterus at least, is attested by the finding of 1 or more plaques in 34 out of 38 irradiated uteri (89%), whereas the plaque was found in only 2 out of 200 non-irradiated uteri (1%) examined specifically for the lesion and in only 5 out of 400 additional non-irradiated uteri (1.25%) subjected to routine examination. Since this plaque is morphologically identical with the early lesion of atherosclerosis as described by Leary (Arch Path 32 507 (1941)), it appears that radiation may be utilized to advantage in the study of the genesis of atherosclerosis.

1323 Greying of Hair I. Effects Produced by Single Doses of X-Rays on Mice by Herman B Chase J Morphology 84 57-76 (1949) Jan

Local areas on C57 Black strain mice were exposed to comparatively low dosages, 31 r to 1000 r, but mostly between 200 r and 500 r at definite times before hair was plucked, at plucking, and at definite times following plucking. Plucking hair by means of the fingers from several separate areas of the coat is the method for obtaining areas in known stages of hair growth. Plucking of club-hairs from an area stimulates the follicles of that area alone to produce the next hair generation. Inactive (Telogen) follicles when x-rayed give in the succeeding hair generations the maximum greying response for the particular dose. Active follicles (Anagen) when x-rayed lose hair already present and the succeeding generations of hair are less grey for the particular dose than those from treated inactive follicles. Epilation and growth retardation and delay effects are opposite in severity to the greying effects, with respect to active or inactive follicles at the time of treatment. The threshold response for follicles treated in the inactive phase occurs with 200 r for 100 kv., 550 r/min. irradiation and with 250 r for 200 kv., 102 r/min. irradiation. There is a graded response. The greying effect is permanent; that is, persists for succeeding hair generations. A discussion of the literature is presented mainly in terms of the degree of sensitivity to greying of different animals and in terms of the irregularity of the response. Considerable regularity of response, in the mouse at least, is obtainable by controlling the stage of hair growth at the time of treatment. A tentative hypothesis is presented involving inactivation or killing of melanoblasts of the dermal reservoir in relation to a melanoblast population cycle associated with epidermal follicle development. Hair development and pigmentation are shown to be separate processes. 26 references.

1324 The Response of Germ Cells to Gonadotropic Hormones in X-Ray Injured Ovaries of Young White Mice by J M Essenberg Western J Surg 57 61-66 (1949) Feb

Most of the ovaries in 34 young mice, 3 to 4 weeks of age, x-rayed with 244 to 300 r remained sterile from 3 to 6 months, the length of the experimental period. Most of the x-rayed ovaries, treated with gonadotropic hormones, either in the form of injection of gonadophysins or the implantation of the pituitary gland, regenerated germ cells and follicles of all sizes except fully formed or graafian follicles. Degeneration of germ cells and follicles occurs simultaneously with germ cells and follicle formation. The cells of degenerated follicles are segregated by connective tissue into alveoli-like structures, which are found in the medulla of hormone-treated ovaries and the entire ovary of x-ray controls. The germinal epithelium was very active in hormone treated ovaries; germ cells were

BIOLOGICAL EFFECTS OF RADIATION (continued)

proliferated and passed through developmental stages before the fully formed stage was reached. Undifferentiated germ cells of germinal epithelium origin may become ova, follicle cells, and probably, interstitial cells. There is great variability; a few x-ray controls may proliferate germ cells spontaneously and some gonadotropin treated ovaries may fail to form germ cells. This study supports the conclusion that in the white mouse, germ cells originate from the germinal epithelium.

1325 Total X-Irradiation of Rats under Urethane Anaesthesia by J A Henry Nature 163 134-135 (1949) Jan 22

Irradiation with LD/50/14 (600 r) resulted in the death of 50% of the controls compared with 90% of the anesthetized rats. Further experiments must be carried out to determine whether urethane anesthesia sensitizes to x-rays or acts cumulatively.

BIOLOGY, GENERAL

1326 The Deposition of Plutonium and Certain Fission Products in Bone as a Decontamination Problem by Joseph G Hamilton, D H Copp, D M Greenberg, M J Chace, L Van Middlesworth and E M Cuthbertson. AECD-2483 (CH-3591) May 15 1946 Decl July 22 1947 98p For publication in NNES

Many of the radioactive elements concerned in nuclear fission are deposited in the skeleton, subjecting the cells of the bone marrow and bone to the chronic effects of toxic radiations. These studies have been concerned with the deposition in bone of plutonium and of the radioactive isotopes of strontium, yttrium, and cerium which are formed by fission. They were conducted with particular reference to the problem of decontamination.

Although most treatments had little influence on the absorption of Sr from the gut, both age and deitary calcium did have a profound effect, and growing rats, on a diet low in calcium, absorbed over 25 times as much of a given dose as did adult rats receiving ample calcium in the diet. There was also a 4-fold difference in the retention of injected radioactive Br when these two extremes were compared, but no appreciable effect on the retention of radioactive Y, Ce, or Pu. Parathormone, massive doses of vitamin D, and "carrier" strontium were found to have little effect on the retention of radioactive Sr.

The chronic elimination by the rat of radioactive Sr, Y, Ce, and Pu was followed for a period of several months. No appreciable decontamination was obtained by prolonged treatment with parathormone, ammonium chloride, sodium citrate, and other methods suggested for the treatment of chronic radium poisoning. The only effect observed was a small increase in the excretion of Sr. Experiments on healing bone fractures showed that the peak uptake of radioactive Pu and Y by the callus occurred several days before the commencement of active calcification and deposition of radioactive Sr. A diet very low in phosphorus was prepared with washed beef blood fibrin as the protein base. Rats weaned to this diet at three weeks of age showed severe signs of phosphorus deficiency within two weeks, including low inorganic blood phosphate, aphosphaturia, and extreme decalcification of the bones. There was a four-fold reduction in the retention of radioactive Sr by these animals, but no significant difference in the retention of radioactive Pu, Y, and Ce. It was found that these effects of severe phosphorus deficiency, including resorption of bone salts, could be produced by adding aluminum sulfate or freshly precipitated aluminum hydroxide to a normal diet. Some demineralization of bone could be produced even in adult animals.

In animals with severe phosphorus deficiency, large areas of the bone, particularly below the epiphysis, consisted of organic matrix free from bone salts. Radioautographs of undecalcified bone sections from such animals showed that the radioactive Sr was deposited only in the presence of bone salts while radioactive Pu, Y, Ce, and Zr were laid down in the uncalcified organic matrix. These, and the preceding metabolic studies, indicate that while Sr follows the path of calcium and is deposited in the mineral of bone, the metabolism of the other elements is unrelated to that of calcium and they may be laid down in the organic bone matrix. Radioautographs of undecalcified bone sections of adult rat demonstrated the superficial deposition of plutonium, and the relative immobility of these deposits.

BIOLOGY, GENERAL (continued)

By this technique, it was shown that these plutonium deposits in the skeleton may be overlayed with newly formed non-radioactive bone, thus shielding the sensitive cells of bone marrow and bone from the short range alpha particles. This has been suggested as a possible means of reducing the chronic toxicity of plutonium in the skeleton. 24 references.

1327 Physico-Chemical Studies of Beryllium Complexes I. Complexing of Beryllium by Citrate by I Feldman, W F Newman, R Danley and J Havill. AECU-133 (UR-59) Jan 19 1949 12p (See also AECU-146)

Ultrafiltration of beryllium solutions shows that a blood constituent likely to form a soluble complex sufficiently undissociated to be of toxicological significance is the citrate ion. The amount of ultrafilterable beryllium is much greater when the beryllium citrate complex is formed before the pH is raised to a value which normally causes precipitation of beryllium hydroxide. 6 references.

1328 A Study of the in Vitro Neutralization of Heparin by Thiazine, Oxazine, Phenazine, and Other Dyes by Thomas J Haley and Frances Stolarsky. AECU-140 (UCLA-7) Feb 24 1949 21p

Nineteen dyes were tested for their ability to inactivate heparin in vitro. Only those belonging to the thiazine, oxazine, and phenazine series, which had a free primary amino group, were active by the method used. Toluidine Blue was the most efficient of all the dyes used.

1329 Physico-Chemical Studies of Beryllium Complexes II An Improved Centrifuge Type of Ultrafiltration Apparatus by I Feldman, R Danley and J O'Leary. AECU-146 (UR-62) Feb 15 1949 10p (See also AECU-133)

An improved centrifuge type of all-glass ultrafiltration apparatus is described. This new design is inexpensive, convenient to use, and easy to clean. With the membrane employed, the ultrafilter was permeable to dissolved beryllium, a low molecular weight colloid, inulin, but impermeable to protein and beryllium hydroxide. Results obtained with this technique were very reproducible.

1330 A Two-Week Beryllium Sulfate Mist Inhalation Study in Animals at a Concentration of 100 MG/M^3 by G Sprague, R Meier, A Pettengill, F Smith, J Scott and H Stokinger. AECU-147 (UR-64) Feb 16 1949 22p

Acute inhalation toxicity of beryllium sulfate has been determined in a preliminary 2-week exposure study in animals, employing the beryllium compound as an aerosol in an attempt to simulate conditions of particulate state and size of industrial exposures about the sulfating and centrifuging processes where mists predominate. The average size of the circulating particles resulting from the beryllium aerosol mist dispersal in the chamber, was 1.1 μ on a mass-median basis with a range of from 0.98 to 1.3 μ as determined by colorimetric analysis of Cascade Impactor samples. The formula of the dispersed agent corresponded most closely to the hexahydrate, $BeSO_4 \cdot 6H_2O$, as indicated from analysis.

At the end of 2 weeks of daily 6-hour exposure, all of 10 rats had died and 3 of 10 guinea pigs and 2 of 10 hamsters, presumably of acute pneumonitis as evidenced by weight loss, and marked only by pulmonary changes. These changes consisted of monocytic and leukocytic exudate in the lung, interstitial and alveolar edema, bronchial ulceration with epithelial proliferation. The degree of pulmonary lesions in the 3 exposed rabbits was the most extensive of any species; these animals survived the exposure and showed no weight loss. From a histologic standpoint, however, this species was considered the most sensitive of the 5 exposed. The mice which also showed no mortality showed marked weight loss and pulmonary edema, bronchial epithelial proliferation and ulceration during the second week of exposure as did most of the animals of this species at the end of the second week. On the whole, however, the toxic response in mice was far less marked than in guinea pigs, rabbits, and hamsters. The exposure to beryllium sulfate hexahydrate at 100 mg/m^3 of air and 1μ mass median particle size produced acute pneumonitis in laboratory animals, was fatal to rats, guinea pigs, and hamsters but not to rabbits and mice following a 2-week daily exposure.

BIOLOGY, GENERAL (continued)

1331 The Metabolism of Carrier-Free Radioberyllium in the Rat by Josephine F Crowley, Joseph G Hamilton and Kenneth G Scott J Biol Chem 177 975-984 (1949) Feb

This article is based on AECD-2254. An abstract of the document has been listed in Nuclear Science Abstracts as abstract No. I-1092.

CHEMISTRY, ANALYTICAL

1332 Tracer Chemistry of Actinium by C K McLane and S Peterson. AECD-2497 (ANL-JJK-14B-168) Dec 1948 Decl Mar 3 1949 14p For publication in NNES

Different problems in the chemistry of tracer concentrations of actinium have been investigated for different purposes. Some phases of the work were concerned with possible separations from lanthanum, others with separations from other elements in the radioactive decay series. Some work was aimed at a better understanding of the +3 state of the heavy elements, in particular americium and curium, while other work was primarily to increase fundamental knowledge of radiochemistry.

The carrying of actinium by zirconium iodate is sensitive to the iodate concentration, varying from less than 10% to over 90% with other conditions unchanged. Neutral salts decrease the carrying; acid exerts a similar but smaller effect. While nitrate ions also decrease carrying, perchlorate ions do not.

Lanthanum can be depleted in actinium by phosphate precipitation. Lanthanum oxalate precipitated from strong acid is depleted in actinium; when precipitated from a concentrated ammonium oxalate solution, it is enriched. Actinium is almost completely carried by barium sulfate; lanthanum interferes. Lanthanum fluoride can be precipitated from most solutions, carrying actinium quantitatively; fluosilicic acid and 5M NH_4NO_3 interfere. Lanthanum hydroxide, cerous hydroxide, and lead sulfate carry actinium nearly completely; uranyl peroxide and zirconium phosphate do not carry actinium.

1333 An Improved Technique for Precise Alpha Radiometric Assay by Edgar F Westrum Jr. AECD-2503 (CN-3433) Jan 16 1946 Decl Mar 3 1949 15p For publication in NNES

An exclusively gravimetric procedure of high precision for aliquoting and plating samples in the determination of amounts and concentrations of radioactive isotopes has been devised and tested. A convenient heating device for preparing uniformly thin films with microgram amounts of solid is described. This is especially practicable for controlled evaporation of solutions such as aqueous sulfuric acid and tetraethylene glycol, which tend to spread over the edge of the counting plate. The technique has been successfully applied to the determination of the specific activity of Pu metal.

1334 The Method of Activation Analysis by G E Boyd. AECD-2507 nd Decl Mar 9 1949 62p Proposed for publication in Analyt Chem

The growth of nuclear science has developed to the point where a new method of analysis for the detection of impurities by forming their artificially radioactive isotopes has become possible for a wide variety of elements. Quite remarkable sensitivity may be attained on occasion by use of the cyclotron or the chain reacting pile. A comparative procedure wherein internal standards are employed is to be recommended in practice, although in principle the absolute quantity of the element sought may be computed directly from the measurements. The feasibility of the application of the method should be determined by a prior consideration of the relevant established nuclear data. The means for nuclear excitation, the kind of instrumentation best suited for radioactivity detection, and the necessity for chemical separations are factors of especial importance. The widespread use of activation analysis in the future appears to hinge in a decisive fashion upon the emergence of machines of relatively modest cost for the laboratory production of artificial radioactivity. 43 references.

1335 Determination of Protoactinium in Urine by E R Russell. AECD-2516 (ANL-4211) Aug 1 1948 Decl Mar 7 1949 4p

The organic matter is oxidized with HNO_3 and the protoactinium is converted to the chloride with HCl. The chloride is the extracted from acid solution with diisopropropyl ketone. Pa^{233} is used as a tracer, and the protoactinium content of the urine determined radiometrically.

CHEMISTRY, ANALYTICAL (continued)

1336 Analytical Chemistry of the Manhattan Project Chapter X Low Pressure Methods by D H Templeton and J I Watters. AECD-2522 nd Decl Mar 11 1949 33p For publication in NNES

Low pressure gasometric methods have an inherent advantage over gravimetric and volumetric methods of extremely high sensitivity. These methods may be made very reliable by using specific properties of the gases for their separation. In recent years, gasometric methods have rapidly advanced in importance for the determination of carbon, oxygen, nitrogen, and hydrogen in metals. This advance has resulted from the recognition of the influence of even low traces of these elements on the properties of metals. In the case of oxygen, there is no other comparable reliable method. The low pressure methods are determining carbon differ radically from the vacuum fusion methods for other elements, including oxygen, hydrogen, and nitrogen. In the carbon determination the constituents of the sample react with oxygen upon being heated in a platinum crucible in an atmosphere of pure oxygen at reduced pressures. The process is accordingly called low pressure combustion. After the combustion has occurred, the oxides of carbon are separated from the oxygen and determined in various ways.

In the vacuum fusion method for oxygen, nitrogen, and hydrogen certain constituents of the sample on being fused react with the carbon of the very hot graphite crucible under a high vacuum. Volatile products such as carbon monoxide, nitrogen, and hydrogen are separated from each other and determined by a variety of methods. All weight calculations can be made on the basis of Boyle's Law. With regard to oxygen and carbon the methods are of course complementary since oxygen is the reagent in the determination of carbon and vice versa. A third type of vacuum procedure called the vacuum extraction method consists of heating the sample in a vacuum until certain volatile constituents are removed. Discussion covers in detail the following: principle of the methods (for carbon, oxygen, nitrogen, and hydrogen), methods of gas analysis, induction heating, apparatus (the carbon apparatus and the vacuum fusion apparatus), and the analysis of various types of samples. 54 references.

1337 Report on the Determination of Citric Acid by Walter Mann and Janet Gruschow. AECU-148 (UR-61) Jan 19 1949 13p

The method, in principle, consists of the conversion of citric acid by means of KBr and acid-permanganate to pentabromacetone; decolorization of the resulting solution is effected with H_2O_2. The solution is then extracted with petroleum ether; the petroleum ether, containing the penta bromacetone, is washed with water and shaken with an aqueous solution of Na_2S whereupon a yellow color develops in the aqueous layer. The colored solution is drawn off and made up to volume with dioxane, the color stabilizer, and read in a Klett photoelectric colorimeter. A number of uncontrolled variables in the procedure were found which gave rise to inconsistent results. A modified procedure is presented which gave improved precision when applied to the analysis of dog and rat urine.

1338 Sodium Peroxide Fusion as an Oxidation Method in Carbon 14 Assay by James C Reid and Laura Tietz. AECU-150 (UCRL-269) Jan 13 1949 12p

The measurement of the radioactivity of an organic substance containing carbon 14 ordinarily involves its conversion to carbon dioxide or to barium carbonate. Fusion in the peroxide bomb has been used for the combustion of organic substances in the analysis for organically bound sulfur, phosphorus, arsenic, and halogens. The procedure is not suitable for carbon, partly because the blank is fairly high and is variable. For the purpose of radioactivity assay, however, it is not necessarily required that the blank be low or constant, and freed of this limitation, peroxide fusion is attractive because of the simplicity of the apparatus and operations and the rapidity with which an ignition can be performed.

1339 Analytical Chemistry and Standards for Nuclear Purity by Jules Gueron. Atomes 4 53-56 (1949) Feb (In French)

The analytical procedures for the production and purification of uranium, heavy water and graphite were among the tasks assigned to the General Chemistry Section of the French Atomic Energy Commission. The activities of some of the groups in this service—specticgraphic, mass spectrographic, colorimetric analyses, and electrochemical—are briefly discussed.

CHEMISTRY, ANALYTICAL (continued)

1340 Method and Apparatus for Physico-Chemical Analysis by L B Lipson. U S Patent No. 2,462,270 (1949) Feb 22

A method is given for determining the amount of a hydrogeneous material in a sample. The dried sample is interposed in the path of fast neutrons; the intensity of the resulting slow neutrons is measured by a Geiger-Müller counter.

CHEMISTRY, GENERAL

1341 The Reduction of Carbon Dioxide to Formic Acid by Weldon G Brown and John G Burr Jr. AECD-2482 nd Decl Feb 18 1949 7p

Carbon dioxide was reduced to formic acid in yields of 71-88% by the action of lithium borohydride in ether solution. Over a series of five runs, the yield of formic acid averaged 79% of the carbon dioxide absorbed by the hydride solution and the absorption of carbon dioxide averaged 81% of the carbon dioxide charged. The method is important as a method of synthesis of formic acid-C^{14} since it does not require the use of elevated temperatures or pressures, or a prior conversion to carbon monoxide. The mechanism of the reaction was shown to be complex. Experimental procedure is given in detail.

1342 Solubility of Protactinium in the Common Acids by Roy C Thompson. AECD-2488 (CC-3637) Oct 7 1946 Decl Mar 1 1949 8p

A preliminary study of the solubility of protactinium in nitric, hydrochloric, sulfuric, perchloric, and hydrofluoric acids leads to the conclusion that such solubility as is exhibited in acid solution may be attributed largely, if not entirely, to the formation of complex ions.

1343 The Hydrolytic Behavior of Zirconium in Perchloric Acid Solution by R E Connick and W H Reas. AECD-2491 (UCRL-261) Sept 1948 Decl Mar 2 1949 28p

The polymerization of zirconium(IV) in 1M and 2M perchloric acid solutions have been investigated using a radioactive zirconium tracer. The extraction of the zirconium chelate of thenoyltrifluoracetone into benzene was measured as a function of the zirconium concentration. Polymer formation is quantitatively reflected as a decrease in the extraction coefficient of the zirconium, and equations expressing this relationship have been developed and applied to the data. In 2M perchloric acid polymers begin to form at zirconium concentrations of approximately 2×10^{-3}M while in 1M perchloric acid they appear at concentrations as low as 2×10^{-4}M. The dimer was shown to exist. It contains between 3 and 5 hydroxide groups. Higher polymers were formed and it is believed that a continuous series of polymers, starting with the dimer, is formed.

Assuming relatively simple relationships between the successive equilibrium quotients for polymer formation, it was shown that theoretical curves could be deduced which fitted the data within the accuracy of the measurements. The limits of the extraction coefficient at low zirconium concentrations indicated that the zirconium(IV) monomer in 1 to 2M perchloric acid solutions is mainly present as unhydrolyzed Zr^{+4}.

1344 Preparation of Calcium Glycolate-1-C^{14} and Calcium Glycolate-2-C^{14} by D M Hughes and B M Tolbert. AECU-121 (UCRL-256) Dec 23 1948 12p

Calcium glycolate-1-C^{14} and calcium glycolate-2-C^{14} have been prepared on a 15 mmole scale in 60-65% yield from the corresponding sodium acetates by the chlorination of anhydrous acetic acid followed by hydrolysis of the chloroacetic acid and the precipitation of the calcium salt of the resulting glycolic acid.

1345 Electrolytic Studies of Aqueous Solutions of Hafnium and Zirconium by J C Griess Jr. AECU-129 (ORNL-204) Feb 15 1949 10p

The behavior of aqueous solutions of zirconium and hafnium under various vonditions of electrolysis has been investigated in the course of research on methods for preparing hafnium-free zirconium.

CHEMISTRY, GENERAL (continued)

It was found possible to obtain polarographic reduction waves for zirconium in perchlorate and chloride solutions, but hafnium was apparently not reducible at the dropping mercury electrode. Neither hafnium nor zirconium could be electrodeposited under the conditions studies.

1346 Biosynthesis of Uric Acid Labeled with Radioactive Carbon by J L Karlsson and H A Barker J Biol Chem 177 597-599 (1949) Feb

Uric acid labeled in various positions with C^{14} was prepared biologically by the use of pigeons. Satisfactory yields and reasonable specific labeling were obtained in preparations of uric acid labeled in the 2 and 8 positions, 4 position, and 6 position, starting with labeled formate, carboxyl-labeled glycine, and labeled bicarbonate, respectively. The method is not suitable for the preparation of uric acid labeled in position 5 from methylene-labeled glycine, because the isotope appears also in the 2, 4, 6, and 8 positions.

COSMIC RADIATION AND MESONS

1347 Absorption in Various Materials of the Radiation Generating Nuclear Evaporations by G Bernardini, G Cortini and A Manfredini Nuovo Cimento 5 511-512 (1948) Oct (In Italian) (Letter to the editor)

In a previous work (Phys Rev 74 845 (1948)) the authors showed that the number of "stars" in a photographic emulsion may serve as an "indicator" of the intensity, at a given altitude, of the primary component of the cosmic radiation. They found that the absorption of the primary component in a material of an atomic number A can be expressed by the cross section formula $\sigma = K A^{2/3}$ cm^2. This result contradicts the findings of Broadbent and Janossi (Proc Roy Soc London 190 497 (1947)) who concluded that the absorption was independent of A. The present authors added new experimental data, using Al as absorber, to their former measurements on Pb. All the data are well expressed by the formula $\sigma = 2.95 \times 10^{-26} A^{2/3}$.

1348 The Absorption of Negative Mesons by E Clementel and G Puppi Nuovo Cimento 5 505-506 (1948) Oct (In Italian) (Letter to the editor)

The difficulty of interpreting the experiments relative to the absorption of negative mesons by the meson theory were recently overcome by Lodge (Nature 161 809 (1948)). The authors, working independently, approached the problem from a similar, although a purely phenomenological, point of view, by considering the heavy and the light mesons as 2 different states of one particle, the passage from one state into the other being accompanied by an emission or an absorption of a neutretto. The equilibrium of these states in a nucleus can be expressed by the equation $Au = B$, where A is the probability of the transition $\mu \rightarrow \pi$, B is the probability of the opposite transition, and u is the neutretto density. The theory leads to the following value of the average lifetime associated with the decay of the heavy meson: $T \cong 1/B = 10^{-9}$ sec. This result agrees with the experimental data.

1349 Angular Distribution of Cosmic Particles in the Stratosphere by S N Vernov and A M Kulikov Doklady Akad Nauk SSSR 61 1013-1015 (1948) Aug 21 (in Russian)

The angular distribution of cosmic rays in the stratosphere was studied in a series of balloon experiments using a three-counter telescope whose axis performed periodic rotations varying its angle with the vertical between 0° and 90°. It follows from the analysis of the curves plotted for various altitudes that the number of particles moving in a direction which forms an angle α with the vertical at an altitude corresponding to a pressure p is equal to the number of particles moving in a vertical direction at an altitude corresponding to a pressure p/Cos α. The important fraction of almost horizontal paths at altitudes exceeding 20 km is explained by the long range of particles moving at about 75° in the rarefied air: these conditions favor the formation of a large number of horizontally moving particles. It is thus shown that the primary particles maintain their original direction in the atmosphere, and that the angular dispersion of the secondary radiation is small. By tying in these facts

COSMIC RADIATION AND MESONS (continued)

with the known large latitude effect in the stratosphere, and with the absence of the azimuthal asymmetry effect, the conclusion is reached that, besides the protons, the primary cosmic rays must contain negative antiprotons.

1350 Disintegration by Mesons by P I Lukirskiĭ and N A Perfilov Doklady Akad Nauk SSSR 61 259-261 (1948) July 11 (In Russian)

Examples are shown of determinations of meson masses from the study of "stars" produced by cosmic rays in photographic emulsions. The disintegrations are assumed to follow a capture by a nucleus of a very slow negative meson (zero kinetic energy and zero momentum). An appropriate reaction equation is written, including symbols for the masses and the energies of the invisible neutrons; only the minimum value of the neutrons' energy can be calculated by using the vector sum of the momenta of the ionizing particles. The examples cited furnished the following meson masses: 292, 420, 670 m_e (m_e is the mass of an electron).

1351 East-West Asymmetry and Latitude Effect of Cosmic Rays at Altitudes up to 33,000 Feet by W C Barber Phys Rev 75 590-599 (1949) Feb 15

By means of triple coincidence telescopes mounted in a B-29 airplane, the east-west asymmetry of cosmic rays has been measured at several geomagnetic latitudes from 0 degrees to 41 degrees north. The asymmetry was determined separately for the hard, soft, and shower-producing components of the radiation. At a zenith angle of 45 degrees, the intensity of each of these components from the western direction exceeded that from the eastern direction by an amount which increased rapidly as the geomagnetic latitude was decreased. Comparison of the amount of asymmetry with the observed latitude effects permits the conclusion that all components arise from primary rays which in the range of energies explored by the experiment are all or nearly all positively charged. During the course of the experiments, vertical intensities of the hard and soft components were also measured. Data on the variation of the vertical intensities with altitude and with geomagnetic latitude are presented. 6 figures 8 tables 10 references.

1352 Generation of Slow Mesons at Various Altitudes by G Cortini, A Manfredini and A Persano Nuovo Cimento 5 507-508 (1948) Oct (In Italian) (Letter to the editor)

Using photographic material obtained in a mountain laboratory (3500 m) and from balloon experiments (17 and 23 km), the authors compared the number of meson tracks in a given emulsion with the number of "stars." It was found that the ratio mesons/stars increases with the altitude. An explanation may be sought in the assumption that there is a rapid increase of intensity toward the lower energies in the spectrum of mesons generated by the primary nucleons. This hypothesis agrees with that of a multiple production of mesons during elementary collisions between nucleons.

1353 Horizontal Component of the Cosmic Radiation at Sea Level by I M Frank and I S Shapiro Doklady Akad Nauk SSSR 61 825-828 (1948) Aug 11 (In Russian)

The very imperfectly known horizontal component at sea level was investigated with the aid of a Wilson chamber and 2 counters (total wall thickness 2.6 g/cm^2 glass), in a brick-walled laboratory (250 g/cm^2). Lead (1 cm and 0.49 cm) and iron (1 cm) plates were placed in succession in the chamber. The low intensity of the radiation necessitated prolonged working of the instrument. The radiation was found to be practically isotropic in the direction close to the horizontal. The intensity of the horizonatal component at sea level is $2 \pm 0.4\%$ of that of the vertical component. It consists mainly of rather soft particles, probably electrons, of an energy order comparable to the critical energy in lead (10^7 ev). Most probably they are generated from the disintegration of stopped mesons.

COSMIC RADIATION AND MESONS (continued)

1354 Ionization Chamber Measurements of Pulses Produced by Cosmic Rays in the Stratosphere by S N Vernov, N L Grigorov and F D Savin Doklady Akad Nauk SSSR 61 815-816 (1948) Aug 11 (In Russian)

The relationship between nuclear disintegrations caused by cosmic rays and the altitude was studied by means of balloons carrying an ionization chamber. The chamber, 10 cm in diameter, was filled with argon at 8 atm pressure. The amplifier was connected with 2 mechanical counters which recorded pulses of magnitudes $> 7.10^4$ and $> 35.10^4$ ion pairs, respectively; the records were transmitted by radio, by way of varying modulating sound frequencies. The curve obtained shows a rapid growth of the number of nuclear disintegration with the altitude; this growth ceases at 14 km. This proves that the disintegrations observed were produced by secondary rays: the growth of the curve would not cease even above 20 km, were primary rays responsible for the nuclear disintegrations.

1355 Mixed Cosmic-Ray Showers at Sea Level by C Y Chao Phys Rev 75 581-590 (1949) Feb 15

A detailed analysis of 15 cloud-chamber photographs of "mixed showers" is given. (A "mixed shower" is a cosmic ray shower produced by penetrating particles consisting both of energetic electrons and of particles heavier than electrons.) This analysis gives the following results: (a) Mixed showers contain, in general, both slow and fast heavy particles in addition to the electron component. Some of the heavy particles can be identified as protons and some as mesons. (b) The electron component of the mixed showers consists sometimes of a single cascade shower and sometimes of several cascade showers. In cases where only a single cascade shower is present its axis is found to be within an angle of 2 or 3 degrees from the direction of the primary particle when this is observable. In cases where several cascade showers appear, one of them often propagates nearly in the direction of the primary particle when this is observable. (c) The simultaneous existence of several cascade showers with their axes diverging at fairly large angles indicates that several high energy electrons or photons are produced in the shower origin. (d) In 3 cases, an electron group is produced below the shower origin by a non-ionizing particle which seems to originate from the primary nuclear event. These particles may be photons. (e) In one case, 2 successive nuclear events are observed which are separated by approximately 60 g/cm^2 of lead. (f) In one case, a star is produced by a penetrating shower particle after traversing approximately 30 g/cm^2 of lead.

1356 Note on the East-West Effect by A T Biehl, H V Neher and Wm C Roesch Phys Rev 75 688-689 (1949) Feb 15 (Letter to the editor)

In a recent flight in a B-29, continuous measurements were made at 3.10 equivalent meters of water barometric pressure (approximately 30,000 feet) of the intensity of cosmic-ray particles at the zenith, 45° west and 45° east. In addition the azimuthal variation was measured over Peru (magnetic latitude zero) at 2.35 m of water (approximately 38,000 feet) for zenith angles of $22\frac{1}{2}$°, 45°, and $67\frac{1}{2}$°. These measurements were made with both 10 cm and 20 cm of lead placed between the counters as well as with no lead absorber. The asymmetries in both the hard and soft components were measured. A summary of the results of 45° zenith angle is given in tabular form; the following conclusions are drawn from these data: (a) That at these altitudes the west excess in the total radiation is nearly as large as in the penetrating component. (b) That the percentage asymmetry is increasing with altitude.

A curve of the percentage west excess as a function of zenith angle with and without lead absorber is shown. This brings out quite clearly the near equality in the asymmetry of the penetrating and soft components. The authors conclude that it is not necessary to assume a different primary particle to account for the penetrating and soft components at the equator and that it is quite likely that only one kind of incident, positively charged particle will suffice.

1357 On Cosmic Ray Mesons by G Puppi Nuovo Cimento 5 587-588 (1948) Dec (In Italian) (Letter to the editor)

The known mesonic processes are examined upon the assumptions that the capture of a negative meson by matter is a purely nuclear process, that a meson of this kind is an ordinary Dirac particle

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(spin $\frac{1}{2}$), and that the heavy meson is an effective "quantum" of the nuclear field. The processes examined are: (1) the decay of the heavy meson ($\pm$), (2) the capture of the ordinary negative meson, and (3) the β-decay of the ordinary meson ($\pm$). Formulas are given for the probability of these processes per unit time. The value of τ for the decay of the heavy meson is found to be equal to 5×10^{-9} sec, in perfect agreement with the experiment. For the β-decay of the ordinary meson the present theory foretells a maximum around 30 Mev in the spectrum of the disintegration electrons. A further consequence of the theory is the equality of the Fermi constants relative to any combinations of Dirac particles.

1358 On Mesons π and μ by R E Marshak Phys Rev 75 700-701 (1949) Feb 15 (Letter to the editor)

The fundamental ideas of the author's "two-meson" hypothesis (Marshak and Bethe, Phys Rev 72 506 (1947)) which was proposed to explain the contradictory behavior of high-altitude and sea-level mesons are clarified and discussed in the light of the latest experimental results. Confirmation of the following points of the hypothesis: (1) the mesons produced with large cross section at high altitudes are different from the majority of weakly interacting sea-level mesons, (2) the high altitude mesons are strongly coupled to nucleons, whereas the sea-level mesons are the decay products of the high altitude mesons, is cited in the work of Powell et al (Nature 162 168 (1948); 162 433 (1948)) and the Berkeley group (Gardner and Lattes, Science 107 270 (1948); Lattes, Science 108 588 (1948)). Definite support for the existence of a weak coupling of sea-level mesons to nucleons which would follow from point (2) of the hypothesis is provided by the measurement of the half-life for π-μ decay (Serber, private communication) and the fact that nuclear capture of π^- converts an appreciable fraction of its rest energy into star energy, whereas nuclear capture of μ^- converts a negligible fraction of its rest mass into star energy. Additional experiments have fixed some of the other unknowns in the two-meson theory. The determination of the ratio of masses of the π-and μ-mesons as 1.321 ± 0.006 (Serber, private communication) and the absence of γ-rays (Piccioni, Phys Rev 74 1236 (1948)) associated with the nuclear capture of μ^- prove that the second particle into which the π-meson decays is a neutrino.

1359 On the "Equilibrium Spectrum" of Avalanche Electrons by S Z Belen'kiĭ Doklady Akad Nauk SSSR 61 621-624 (1948) Aug 1 (In Russian)

In a paper on the electron component of the cosmic radiation at sea level, Bernardini, Caccipuoti, and Querzelli (Phys Rev 73 No. 4 (1948)) use a function giving the total number of electrons created by a primary electron and possessing an energy superior to a given value. The authors attribute the derivation of this formula to Feretti (Ricerca Sci 10 532 (1942)). However, prior to this date, Tamm and Belen'kiĭ (J Physics USSR 1 3 and 177 (1939); Phys Rev 70 660 (1946)) derived a similar formula. In the present work an estimation is made of this formula's degree of exactitude.

1360 On the Structure of the Extensive Atmospheric Showers by D M Alekseev, G T Zatsepin and I G Morozov Doklady Akad Nauk SSSR 61 457-458 (1948) July 21 (In Russian)

The fact (Zatsepin and Miller, Zhur Eksptl i Teoret Fiz 17 939 (1947)) that the registration of extensive showers is still observable between 2 counter systems S_1 and S_2 at distances reaching 600-1000 m, was submitted to further study at 3860 m altitude. In addition to coincidences C_4 from S_1 and S_2, the coincidences C_5 with a central counter group were recorded. According to the cascade theory, an electron-photon shower has a certain mean-square-root radius R_0 (R_0 = 100 m for p = 480 mm Hg at the altitude 3860 m), the shower density decreasing rapidly outside R_0. As a consequence, the ratio C_5/C_4 must grow with the distance between S_1 and S_2. The actual measurements showed the opposite effect: the ratio C_5/C_4 decreased from 0.77 ± 0.015 to 0.66 ± 0.075 when the distances grew from 2 to 600 m. These results confirm the hypothesis that the extensive atmospheric showers possess a "structure," perhaps in the shape of several "trunks" (Skobeltsin, Zatsepin and Miller, Phys Rev 71 315 (1947)).

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1361 The Penetration of μ-Meson Decay Electrons and Their Bremsstrahlung Radiation by E P Hincks and B Pontecorvo Phys Rev 75 698-699 (1949) Feb 15 (Letter to the editor)

Measurements of the penetration of the charged particles from the 2.2-μsec. meson decay using the arrangement of counters and delayed coincidence circuits previously described (Phys Rev 74 697 (1948)) have been extended with absorbers of lead and aluminum, in addition to carbon. The results confirm a previous conclusion that at least a substantial number of particles have an energy > 25 Mev. Tabulated data are shown which cause the authors to conclude that the "hard" component is bremsstrahlung radiation produced by the charged particles of the "soft" component. The consequences of this conclusion are discussed.

1362 The Positive Excess of the Penetrating Component in High Altitude by I F Quercia, B Rispoli and S Sciuti Nuovo Cimento 5 397-398 (1948) Aug (In Italian) (Letter to the editor) (See also Nuclear Science Abstract No. II-440)

Using the method described in Nuovo Cimento 4 283 (1947), new measurements were made of the positive excess of the penetrating component of cosmic rays during several airplane flights at 5000 m and 7300 m altitude. It was observed that between these altitudes the δ-effect does not increase, while the positive excess tends to decrease. The following are the most probable conclusions from the observations made: (1) The mesons are generated in the atmosphere by protons and by a neutral radiation; (2) the multiplication during the process of generation by protons decreases with the latter's energy; this can explain the increase of the positive excess with the altitude, and its decrease with the azimuthal angle; (3) at about 7000 m a neutral component (probably neutrons) is generating mesons with considerable intensity, the effect being a local masking of the increase of the positive excess.

1363 The Production of Meson Pairs in Various Materials by J Clay Physica 14 495-499 (1948) Dec

The production of meson pairs in H_2O, paraffin, Al, Fe, and Pb has been measured at sea level by means of a sixfold coincidence arrangement of 3 piles of counter-trays. Each of the trays was covered with 10 cm of Pb. By means of a covering tray of counters the producing particle was examined. The numbers of meson pairs produced was found to be proportional to the number of atomic nuclei in the layers. The angle between the 2 particles was determined as less than 24°. The number of pair-producing particles was estimated as 1/16000 of the meson component of the radiation. The producing particle does not produce ionization and is probably a photon, as the absorption is small in H_2O and paraffin and increases in Fe and Pb. No correlation between the pair-producing particles and the extensive showers was found.

1364 Relation of the Cosmic Radiation to Sunspot Magnetic Moments by James W Broxon Phys Rev 75 612-619 (1949) Feb 15

A function (SS-MM) designed to represent the arithmetical sum of the magnetic moments of all visible sunspots has been compared statistically with the intensity of the cosmic radiation (C-R). Large pulses (20 to 30%) in SS-MM were found to occur out of phase with primary pulses in C-R. SS-MM pulses of comparable magnitude bore different phase relations to subsidiary pulses in C-R. For subsidiary pulses preceding the primaries, the C-R was generally high when the SS-MM was increasing and low when it was decreasing. For subsidiary pulses following the primaries, the C-R was generally high when the SS-MM was decreasing and low when it was increasing. The analysis was carried out for intervals of 60 days preceding and following the selected days of high or low C-R. Some consideration was given to the emf generated in connection with an imaginary but in some respects representative sunspot by electromagnetic induction.

1365 The Spectrum of the Soft, Electronic, Part of the Cosmic Radiation by J Clay Physica 14 499-504 (1948) Dec

When the absorption of the electronic component of cosmic radiation in 2 materials, such as Al and Pb, is compared, it is possible to express one of the materials in terms of an equivalent layer of

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the other, i.e., 3 cm Al = 1 cm Pb. The difference between the total absorption in such equivalent layers can be used to determine the number of electrons between two energy values. These values can be found using Scheen's formula (Physica 13 669 (1947)) for the range of electrons. The energy spectrum of electrons in the atmosphere was thus determined as $N(E) = N_0E^{-1.27}dE$; this value is in good agreement with the value $N(E) = N_0E^{-1.35}dE$ calculated from the absorption spectrums in Fe and C.

1366 Transition Effect of Cosmic Rays in the Stratosphere by S I Brikker, S N Vernov, N L Grigorov, I M Evreinova and T N Charakhch'an Doklady Akad Nauk SSSR 61 629-631 (1948) Aug 1 (In Russian)

A strong transition effect in the stratosphere, described by the authors in a former paper (Doklady Akad Nauk SSSR 57 No. 2 (1947)) was subjected to a further study. Small counters were enclosed in spherical lead shells (1-4 cm thick, 4-6 cm inner diameter); the balloons reached 30 km altitude. The analysis of the curves showed that the generating particles were electrons of about 10^8 ev energy. One source of these electrons, evidently present in large quantity in the stratosphere, may be seen in the disintegration of mesons. However, it is known that at altitudes exceeding 20 km the number of mesons present is not great, the bulk of the hard component consisting of protons. Calculations showed that only about one half of the energy of the electron component could have originated from mesons.

CRYSTALLOGRAPHY AND CRYSTAL STRUCTURE

1367 Change in Density of Potassium Chloride Crystals upon Irradiation with X-Rays by I Estermann, W J Leivo and O Stern Phys Rev 75 627-633 (1949) Feb 15

Alkali halide crystals become colored when irradiated with x-rays and theoretical considerations indicate that the coloration is due to absorption centers which consist of electrons trapped at negative ion vacancies. Precision measurements of the density of uncolored crystals, however, indicate that it is very unlikely that there is a sufficient number of vacancies present in well annealed crystals to account for the number of color centers, which may be determined optically, unless vacancies are formed as a result of the irradiation. Potassium chloride crystals were irradiated with x-rays. Their change in density was measured by the "crystal suspension method." It was found that the crystals changed in density, and that the number of vacancies calculated from the decrease in density was in reasonable agreement with the number of color centers determined by optical measurement.

1368 Statistical Accuracy of Geiger Counter Measurements of X-ray Diffraction Lines by W H Hall J Sci Instruments 26 61 (1949) Feb (Letter to the editor)

The author estimates the effect of statistical fluctuations upon the counting rate of Geiger counters as applied to the measurement of intensities of x-ray diffraction lines. The calculations made lead to the conclusion that it is possible to make accurate measurements of integrated intensities, since the numerical magnitudes of these intensities are so low that relatively large errors in them are insignificant. A further consequence of the calculations is the fact that the statistical accuracy of measurements of integrated intensity is independent of the slit width used. Finally, it is concluded that integral breadths of lines can also be measured with considerable accuracy, since only measurements of the integrated intensity and the peak counting-rate are required.

DEUTERIUM AND DEUTERIUM COMPOUNDS

1369 The Determination of Heavy Water by I E Puddington Can J Research 27 B 1-5 (1949) Jan

A reasonably simple procedure for determining the concentration of heavy water solutions, based on the comparison of the vapor pressures of these solutions with pure water, has been developed. The method is useful for samples as small as 0.5 mgm and the sample may be recovered. Individual determinations require about 2 hours. In the work reported, mean determinations did not vary from the best curve through the experimental points by more than 0.2 mole % of D_2O, while the spread in any group of readings was about $\pm$ 0.25 mole %. This paper is based on NRC No. 1858.

DEUTERIUM AND DEUTERIUM COMPOUNDS (continued)

1370 A Study of the High Frequency Fundamental Bands in the Spectrum of AsH_3 and AsD_3 by Virginia Marie McConaghie and Harald H Nielsen Phys Rev 75 633-640 (1949) Feb 15

An analysis has been carried out on the fundamental bands ν_1 and ν_2 (Dennison, Revs Modern Physics 12 175 (1940)) in the infra-red spectrum of AsH_3. This analysis has made possible the evaluation of the reciprocals of inertia, B, and the Coriolis coupling coefficient, ζ_2. These are found to be $B'' = 3.723\ cm^{-1}$, $B'(\nu_1) = 3.682\ cm^{-1}$, $B'(\nu_2) = 3.69\ cm^{-1}$ and $\zeta_2 = -0.0602$. The harmonic vibration frequencies have been computed after the method of Dennison. The values obtained are $\omega_1 = 2209.2\ cm^{-1}$, $\omega_2 = 2225.8\ cm^{-1}$, $\omega_3 = 973.3\ cm^{-1}$, and $\omega_4 = 1012.1\ cm^{-1}$ for the AsH_3 molecule and $\omega_1 = 1571.2\ cm^{-1}$, $\omega_2 = 1582.4\ cm^{-1}$, $\omega_3 = 696\ cm^{-1}$, and $\omega_4 = 718.6\ cm^{-1}$ for AsD_3. This information permits the calculation of ζ_2 for AsD_3. A value $\zeta_2 = -0.0383$ is obtained which is in satisfactory agreement with experimental data. For AsD_3 the following B values prevail; $B'' = 1.896\ cm^{-1}$, $B'(\nu_1) = 1.883\ cm^{-1}$, and $B'(\nu_2) = 1.874\ cm^{-1}$. The B″ values obtained enable one to estimate closely that the value of r(As-H) is equal to 1.513A and the H-As-H angle is equal to 89°50′.

HEALTH PROTECTION

1371 Medical Control of Beryllium Poisoning by Irving R Tabershaw, Cyril Dustan and Leonard J Goldwater. AECU-117 (CUG-1) Feb 1 1949 19p

This report details a program for the medical control of individuals exposed to beryllium and its compounds. The recommendations are based on data gathered in studies of plants producing beryllium salts from beryl ore. The literature was reviewed and a summary made of the essential information now available which is pertinent to designing medical procedures in the prevention, care, and follow-up of workers exposed to beryllium and those with overt or suspected cases of both the acute and chronic disease. Recommendations are made on the scope and interval of physical examinations as well as the medical handling of possible cases. Medical criteria for employment are suggested for individuals applying for work in plants using beryllium. 29 references.

1372 Method for Monitoring $C^{14}O_2$ Air Contamination by Robert Ballentine and William Bernstein. AECU-118 (BNL-T-5) nd 8p

This report presents in outline a method whereby tolerance levels of 3×10^{-8} microcuries/milliliter of air may be readily measured. The sample is collected by trapping the metered, dried air in a spiral cooled to –193°C with liquid nitrogen. A flow rate of 2 liters per minute can be accomodated with quantitative recovery of CO_2. The sample is then transferred by simple vacuum technique to a gas-filled methane proportional counter. Preliminary data indicate that a counting geometry for $C^{14}O_2$ of approximately 60-70 per cent is obtained.

INSTRUMENTS

1373 A Semi-Microcalorimeter for Precise Thermochemical Measurements by Edgar F Westrum Jr and Herman P Robinson. AECD-2520 (ANL-JJK-14B-155) Dec 1947 Decl Mar 9 1949 31p For publication in NNES

The construction, calibration, and operation of a calorimeter of about 200 calorie heat capacity and a temperature sensitivity of 2×10^{-5} °C and auxiliary equipment are described. The calorimeter was designed to measure heats of reaction and solution accurate to several tenths of a kilocalorie on about 10^{-4} moles of plutonium and plutonium compounds.

1374 An Apparatus for Measuring Dielectric Constant and Power Factor at Radio Frequencies by H S McKown. AECU-126 (K-349) Feb 20 1949 14p

An apparatus to measure the dielectric constant and power factor of plastic materials at 500,000 and 1,000,000 cycles per second has been constructed and put into operation. It is based on a resonant circuit substitution method where the unknown dielectric is replaced by a standard condenser and a special noninductive resistor in parallel.

ISOTOPES

1375 The History of Oxygen by Malcolm Dole Science 109 77-81 and 96 (1949) Jan 28

The problem of explaining the existence of free uncombined oxygen in the atmosphere is discussed in terms of theories of the origin of our solar system. Forty possible photochemical and ionic processes which are believed to exist or which are believed capable of existing in the stratosphere or ionosphere have been tabulated from various sources. Some possible sequences which may have given rise to free atmospheric oxygen are discussed with respect to the energies involved in the process. The significance of the difference in isotopic composition between that of the atmosphere and that of the water of the oceans is noted and various explanations of this phenomenon are explored.

1376 On the Origin of the Chemical Elements by D ter Haar Science 109 81-82 (1949) Jan 28

An attempt is made to correlate the theories which have been advanced to explain the observed abundance of the chemical elements and their isotopes with the general cosmogeny developed by von Weizsäcker (Zeitschrift für Astrophysik 24 278 (1948)). The author simplifies the initial conditions assumed by the latter by bringing the problem of the origin of the chemical elements, other than hydrogen, into the present epoch. Some qualitative results are given and the basis of a quantitative correlation is indicated.

MASS SPECTROGRAPHY

1377 Mass Spectrometry by Robert V Langmuir, assignor to Consolidated Engineering Corp., Pasadena, Calif. U S Patents Nos. 2,463,544 and 2,463,545 (1949) March 8 (see also Nuclear Science Abstract No. II-508)

The speed of the analysis of a gas sample by mass spectrometry can be increased markedly by producing a pulsating ion current, which can be amplified with an alternating current amplifier. The required oscillation may be brought about (1) by varying the intensity of the beam of ionizing particles (such as electrons) with which the gas in the mass spectrometer is bombarded; (2) by varying the velocity of these ionizing particles; and (3) by varying the field forces which control the deflections of the ions for their separation.

METALS AND METALLURGY

1378 The MBe^{13} Compounds by N C Baenziger and R E Rundle. AECD-2506 (ISC-30) nd Decl Mar 2 1949 4p Proposed for publication in Acta Cryst

A series of intermetallic compounds of composition MBe^{13} has been found, where M is U, Th, Ce, and Zr. Powder diagrams of the phases appear to be simple cubic, $a \cong 5A$, but rotation and Weissenberg diagrams of $ZrBe^{13}$ reveal that the true unit is face-centered cubic, $a \cong 10$ A, and with 8 $ZrBe^{13}$ per unit. Upon close inspection the (531) reflection, requiring the larger unit, can be seen on powder diagrams of all four compounds. The lattice constants reported are from back reflections obtained with a symmetrical, self-focusing powder camera. 5 references.

1379 An Appraisal of the Usefulness of Aluminum Alloys for Supersonic Aircraft and Guided Missile Construction by C M Craighead, L W Eastwood and C H Lorig. Douglas Aircraft Co Inc Project Rand Report R-104 Aug 8 1948 (Battelle Memorial Institute) 240p

The primary objective of this survey is directed toward an appraisal of aluminum for use in supersonic vehicles. In such applications a knowledge of how the materials of construction are affected by temperatures is essential, for temperatures may range from subatmospheric, such as that of liquid hydrogen, to extremely high values well above the melting points of the ordinary metals and alloys. In some circumstances the exposure may be very short, or again it may be of prolonged duration. With these requirements in mind, data on the properties of aluminum alloys as affected by temperature are assembled from the various sources. Within the body of this report the limitations of existing information are pointed out, consideration is given to such research and development work as is known to be in progress in the various fields, and an engineering appraisal of possible future developments in aluminum alloys is postulated. Insofar as data are available, consideration is also given to corrosion

METALS AND METALLURGY (continued)

characteristics of aluminum and its alloys in special media (propellants). The available information on the properties of aluminum alloys as affected by temperature is assembled as an Appendix to this report. 95 references.

1380 Electrodeposition and Electrowinning of Germanium by Colin G Fink and Vasant M Dokras Electrochem Soc J 95 80-97 (1949) Feb

Aqueous, non-aqueous, and fused electrolytes were studied. The electrodeposition of germanium from aqueous baths is apparently limited to thin flashes of the metal because of the very low overvoltage of hydrogen on germanium. Copper, silver, tin, cobalt, and nickel were each co-deposited with germanium from aqueous solutions. The silver-white inter-metallic compound, Cu_3Ge, was deposited from an alkaline solution. Also described is a method for electrodepositing germanium from a solution of germanium tetraiodide in ethylene glycol and from a fused electrolyte of borax in which germanium dioxide was dissolved. The chemical resistance of the Cu_3Ge plate is good and it may have considerable protective value.

1381 Radioactive Metal Products and Methods of Making Same by C W Wallhausen and H H Dooley, Morristown, N J, assignors to U S Radium Corp, New York, N Y U S Patent No. 2,462,241 (1949) Feb 22

A method is given of preparing a mixture of metallic gold and a radioactive compound by precipitating them from an aqueous solution of a reducible gold salt and a water-soluble salt of a radioactive element.

MINERAL RESOURCES AND MINERALOGY

1382 Determination of Radioactive Content of Rocks by Means of Geiger-Müller Counters by A Szalay and Eve Csongor Science 109 146-147 (1949) Feb 11

During a survey of the Velence Mountains in Hungary the authors developed a direct approximating method for use in determining the radioactive content of rocks by means of a Geiger-Müller counter. The calibration method used is outlined and the calibration obtained can be expressed by the following approximate numerical formula: $c = 2.4 \cdot 10^{-5} \frac{J}{LD}$, where c is the concentration in g-Th-equivalents/g of rock; J, the counting rate (in min); L the length; and D the diameter (in cm) of the brass cathode of the counter tube. Similarly the concentration in g-U-equivalents/g of rock can be expressed by the approximate numerical formula: $c = 1.4 \cdot 10^{-5} \frac{J}{LD}$. The use of the following roughly approximating simple rule may be suggested for uranium explorers when extended territories must be surveyed within a short time: if a G-M counter of any commercial dimensions, shielded by 2 mm of lead, is placed against the rock wall and the observed counting rate (minus cosmic radiation) is x times the rate of cosmic radiation for the same counter, then the average U concentration in the rock is x times 25 g U/metric ton (1,000 kg) of rock.

NEUTRONS

1383 Neutron and Proton Binding Energies in the Region of Lead by Katherine Way. AECD-2484 nd Decl Feb 18 1949 3p

Assuming that the individual Bohr-Wheeler values for the binding of a neutron to U^{234}, U^{235}, U^{236} and U^{237} are correct, the binding energies in the region of Pb from known α- and β-decay energies can be calculated. For instance $B_n(A-4, Z-2) = B_n(A, Z) - E\alpha_1 - E\alpha_2$, where $B_n(A,Z)$ is the binding energy of a neutron to a nucleus with mass A and charge Z and $E\alpha_1$ and $E\alpha_2$ are the disintegration energies associated with the emission of α-particles from the nuclei (A,Z) and (A + 1, Z). A similar relation holds for β-decay, but here the uncertainties of the results are greater than in the α cases since in many cases decay schemes have not been worked out. Some checks were possible from stability considerations and cycle calculations. In some cases, it is necessary to depend on cycle calculations entirely. By such a calculation is meant the value found by requiring disintegration energies leading from the same initial to the same final nucleus to be equal. Neutron and proton binding energies for Tl, Pb, Bi, Po, and At isotopes are tabulated.

NEUTRONS (continued)

1384 Introduction to "The Design and Construction of Boron Coated Thermopiles for Use in Neutron Fields" (Note on the Generation of Thermoelectric EMF's by the Heat of Nuclear Reactions) by G Barbaras, J Farr, J Kuranz et al. AECD-2485 nd Decl Feb 28 1949 6p

A multi-junction thermopile has been constructed with every other junction coated with boron. When placed in a neutron field, an emf will appear across the terminals since the coated junctions will become hotter than the uncoated. The temperature difference will be proportional to the neutron flux and consequently the EMF developed across the terminals of the thermopile will also be proportional to the neutron flux. Because such an instrument as a thermopile requires no batteries or exterior equipment, it makes a very handy safety device for high slow neutron fluxes. A photograph of the instrument is shown. This instrument has been successfully employed in measuring the neutron flux of a chain reacting pile.

1385 Some Isotopic Neutron Absorption Cross Sections by H S Pomerance. AECD-2502 nd Decl Feb 18 1949 1p Proposed for publication in J Amer Phys Soc (See also MDDC-1650)

This document is an abstract; it is reproduced below in its entirety.

The Oak Ridge pile oscillator (Hoover et al, Phys Rev 74 864 (1948)) was designed to measure thermal neutron absorption cross sections of small samples. At present macroscopic cross sections of 0.1 mm^2 can be detected and 1 mm^2 can be measured with 10% accuracy. Many enriched isotopes produced at the Oak Ridge electromagnetic plant (Y-12) are available in sufficient weight to be used. For four elements, the isotopes have been measured and the weighted sum of the isotopic cross sections times their respective abundances have been compared with the cross sections for the normal element. The results are:

Cr^{50} - 16.3 b;	Cr^{52} - 0.73 b;	Cr^{53} - 17.5 b;
Cr^{54} - ±0.3 b;	Ni^{58} - 4.17 b;	Ni^{60} - 2.72 b;
Ni^{61} - 1.8 b;	Ni^{62} - 14.8 b;	Cu^{63} - 4.29 b;
Cu^{65} - 2.11 b;	Zr^{90} - 0.116 b;	Zr^{91} - 1.54 b;
Zr^{92} - 0.269 b;	Zr^{94} - 0.116 b; Zr	Zr^{96} - 0.294 b.

Estimated accuracies vary from 25% for the zirconium to 5% for the copper.

1386 Thermal Neutron Fission Properties of Ac^{227}, Ra^{223}, and Ra^{228} by S Peterson and A Ghiorso. AECD-2514 (ANL-JJK-14B-156) nd Decl Mar 8 1949 4p For publication in NNES

A preliminary study has been made of the thermal neutron fission properties of several naturally occurring radioisotopes. Limits on thermal fission cross-sections have been determined as follows: $Ac^{227} < 2 \times 10^{-24}$ cm^2; $Ra^{223} < 100 \times 10^{-24}$ cm^2; $Ra228 < 2 \times 10^{-24}$ cm^2. Fission measurements were made in the thermal column of the Argonne heavy-water pile. The procedure for the separation and purification of the several isotopes measured are briefly described.

1387 Table of the Functions: $S_0(x)$, $C_0(x)$, $E_0(x)$, $S_0(x)$ and $C_0(x)$ by B Carlson and M Goldstein. AECU-124 (LAMS-832) Jan 13 1949 8p

The functions tabulated in this report are useful in one-velocity neutron diffusion calculations, and are defined as follows: $S_0(x) = \frac{\sin x}{x}$; $C_0(x) = x \cot x$; $E_0(x) = \frac{e^{-x}}{x}$; $S_0(x) = \frac{\sinh x}{x}$; $C_0(x) = x \coth x$.

1388 The Total Cross Section of the He^3 Nucleus for Slow Neutrons by L D P King and L Goldstein. AECU-127 (LA-721) Jan 4 1949 15p

Using the slow neutrons available from the thermal column of the enriched uranium pile of the Los Alamos laboratory, the total cross section of the He^3 nucleus was determined by the transmission method. Regarding the precision of the data, this cross section obeys the 1/v law in the range of

NEUTRONS (continued)

averaged neutron energies extending from about 0.001 to 0.03 electron volts. The product (σ_{He^3} X v) is found to be (11.2 ± 0.5) x 10^6 barns x meters x sec^{-1}. The possible theoretical implications of these results are briefly discussed in connection with the properties of the compound He^4 nucleus.

1389 On the Analysis of Neutron-Proton Scattering with Tensor Forces by R S Christian. AECU-142 (UCRL-287) Feb 11 1949 8p

A perturbation method proposed by Chew and Goldberger for the analysis of nucleon-nucleon scattering by central forces is extended to include tensor force scattering.

1390 Magnetic Refraction of Neutrons at Domain Boundaries by D J Hughes, M T Burgy, R B Heller and J W Wallace. Phys Rev 75 565-569 (1949) Feb 15

This article is based on AECD-2363. An abstract of the document has been listed in Nuclear Science Abstracts as abstract No. I-1637.

1391 Neutron-Proton Scattering at 90 Mev by Keith Brueckner, Walter Hartsough, Evans Hayward and Wilson M Powell Phys Rev 75 555-564 (1949) Feb 15

This article is based on AECD-2369. An abstract of the document has been listed in Nuclear Science Abstracts as abstract No. I-1856.

1392 Neutrons from Deuteron Bombardment of Li^6 by Ward Whaling, J E Evans and T W Bonner Phys Rev 75 688 (1949) Feb 15 (Letter to the editor)

The number of neutrons from monoenergetic deuteron bombardment of Li^6 has been measured for deuterons of energy between 250 and 2200 Kev. These neutrons are thought to come from the 2 reactions: $Li^6 + H^2 \rightarrow (*Be^8) \rightarrow Be^7 + n + 3.3$ Mev, and $Li^6 + H^2 \rightarrow (*Be^8) \rightarrow He^4 + He^3 + n + 1.7$ Mev. Lithium enriched to 95% Li^6 was used as a target in the form of a thin film of Li_2SO_4 and the neutrons emitted in the direction of the deuteron beam were detected by means of the argon recoils in a proportional counter filled with argon at atmospheric pressure. Curves are shown for the relative number of neutrons from the 2 isotopes, Li^6 and Li^7 (observed in the direction of the deuteron beam) as a function of deuteron energy, and the angular distribution data obtained are noted. Some possible conclusions as to the energy levels in Be^8 are discussed.

1393 Relative Cross Sections for Nuclear Reactions Induced by High Energy Neutrons in Light Elements by William J Knox Phys Rev 75 537-541 (1949) Feb 15

This article is based on AECD-2340. An abstract of the document has been listed in Nuclear Science Abstracts as abstract No. I-1631.

1394 Spin Dependence of Slow Neutron Scattering by Deuterons by E Fermi and L Marshall Phys Rev 75 578-580 (1949) Feb 15

This article is based on AECD-2343. An abstract of the document has been listed in Nuclear Science Abstracts as abstract No. I-1633.

NUCLEAR PROPERTIES

1395 Cross-Section for the Disintegration of the Deuteron by 2.76 Mev. γ-Rays by R Wilson, C H Collie and H Halban Nature 163 245-246 (1949) Feb 12

In view of the high value for the cross section for photodisintegration of deuterium with radiothorium γ-rays (Nature 162 185 (1948)), the authors decided to repeat the measurements with a radiosodium source since, from various considerations which are discussed, they conclude that the radiosodium calibration is more accurate than the radiothorium calibration. Several improvements in the apparatus and techniques used were also made and a redetermined decay period of radiosodium of 14.90 ± 0.02 hr was used (Bishop and Wilson, in course of publication). The experimental value of the cross section for the disintegration of the deuteron by 2.76 Mev γ-rays was found to be 14.8 ± 1.0, using radiothorium as compared with the value of 15.6 ± 1.0 which was obtained when radiosodium was used. These values give a ratio of 1.05 ± 0.08. The authors note that this constitutes a discrepancy when compared with Hulthen's theoretical values of 1.21 and 1.22 for the ratio (Private communication), for meson masses of 296 and 197, respectively. Since these measurements were made, a new value for the binding energy of deuterium has been published (Bell and Elliott, Phys Rev 74 1552 (1948)). The cross sections for this value (2.237 Mev) of the binding energy are lower by about 10%.

1396 The Hyperfine Structure of Na^{22} by L Davis Jr. MIT Research Laboratory of Electronics Technical Report No. 88 Dec 1 1948 57p (NP-631)

The hyperfine structure of the ground state of artificially radioactive Na^{22} has been studied by the atomic beam magnetic resonance method. Observation of the Zeeman splitting of the hyperfine structure in a very weak known external magnetic field determines the nuclear angular momentum I to be 3 in units of $h/2\pi$. The measurement of the frequency of an identified transition between two energy levels of the hyperfine structure in a known external magnetic field of a few gauss yields, with a very small correction for field, the value of the hyperfine structure separation $\Delta\nu$ equal to $1220.64 \pm .04$ megacycles per second. Values of $\Delta\nu$ calculated from transitions observed at several values of external magnetic field permit the assignment of a positive sign to the nuclear magnetic dipole moment. By the comparison of I and $\Delta\nu$ of Na^{22} to the known properties of Na^{23} the nuclear magnetic dipole moment μ_I of Na^{22} is found to be $1.746 \pm .003$ nuclear magnetons. The value of the nuclear angular momentum I is consistent with the reported decay scheme of Na^{22} and beta decay theory.

1397 A New Suggestion for Aligning Certain Atomic Nuclei by C J Gorter Physica 14 504 (1948) Dec (Letter to the editor)

A method for alignment of the nuclei of some paramagnetic ions which avoids the difficult two-stage cooling procedures is described. If a salt contains normal paramagnetic ions having hyperfine structures of the order of 0.01 to 0.1 cm^{-1} for nuclei possessing a nuclear magnetic moment of about one nuclear magneton, this method may be used. To cool the salt it is mixed with another salt having paramagnetic ions which have no nuclear moment (as chromium) in such a way as to obtain a good thermal contact. If the mixture is then demagnetized, the bulk of the nuclear moments should be aligned.

1398 On the Form of the Signals Observed with a Nuclear Inductor by L Giulotto Nuova Cimento 5 498-504 (1948) Oct (In Italian)

The form of the proton signals obtained in water with a nuclear inductor under various experimental conditions is discussed. The results are in agreement with the predictions of Bloch's theory (Phys Rev 70 460 (1946) . 9 references.

NUCLEAR PROPERTIES (continued)

1399 On the Magnetic Moments of C^{13}, F^{19}, Tl^{203}, and Tl^{205} by H L Poss Phys Rev 75 600-606 (1949) Feb 15

The resonance absorption method has been applied to the measurements of the moments of C^{13}, F^{19}, Tl^{203}, and Tl^{205} in terms of the proton moment. The observed ratios of g-factor to that of the proton are as follows. C^{13}: 0.25143 ± 0.00005; F^{19}: 0.94077 ± 0.0001; Tl^{203}: 0.571499 ± 0.00005; Tl^{205}: 0.577135 ± 0.00005. By taking 5.5791 ± 0.0016 for the proton gyromagnetic ratio, the values of the moments in nuclear magnetons are: $\mu(C^{13}) = 0.7016 \pm 0.0004$; $\mu(F^{19}) = 2.626 \pm 0.001$; $\mu(Tl^{203}) = 1.612$; $\mu(Tl^{205}) = 1.628$. For the thallium isotopes, $\mu_{205}/\mu_{203} = 1.00986 \pm 0.00005$. The results for C^{13} and F^{19} are in close agreement with the molecular-beam values. 20 references.

1400 What is Nuclear Force? by Herbert Chatley J Junior Inst Engrs 59 141-149 (1949) Feb

The author presents a few of the concepts of nuclear physics in simple form; nuclear structure hypotheses, the nature of nuclear forces, Yukawa's meson theory, and the significance of "spin" are all treated briefly.

NUCLEAR TRANSFORMATION

1401 Carbon 14 from Lead Nitrate by Martin R Goodman and Andrew Longacre. AECU-139 (ORNL-296) Mar 1 1949 17p

By means of the reaction $N^{14}(n,p)C^{14}$, carbon 14 was produced from $Pb(NO_3)_2$ in the Oak Ridge Nuclear Reactor. The apparatus was designed to permit continuous extraction of the resulting C^{14} by means of flushing with a suitable gas stream or by evacuation. The carbon 14, appearing entirely as $C^{14}O_2$, was trapped in $Ba(OH)_2$ and 2.7% C^{14}. Chemical processing of the lead nitrate gave 3.7% C^{14}. Details are given of the equipment, process and procedure.

1402 Mass Spectrographic Assignment of Cs^{131} by D G Karraker, F L Reynolds and D H Templeton. AECU-143 (UCRL-285) Feb 11 1949 4p

Irradiation of normal barium with neutrons and deuterons produced a 12-day barium activity which decays by orbital electron capture to a 10-day cesium, which in turn captures an electron to form stable xenon. Consideration of the known facts led to mass 131 as the most reasonable assignment for this decay chain. This assignment was confirmed by a mass spectrographic technique. An appendix outlines a chromatographic method for separation of carrier-free cesium from irradiated $Ba(NO_3)_2$.

1403 Cross Section for the Reaction $N^{14}(He^3,\alpha)N^{13}$ for 8.3 Mev He^3 Particles by E J Stovall. AECU-144 (LAMS-820) Jan 12 1949 8p

An upper limit for the cross section of the reaction $N^{14}(He^3,\alpha)N^{13}$, using as a source of He^3 particles the $D(d,n)He^3$ reaction, has been determined to be $(1 + 1) \times 10^{-24}$ cm^2.

1404 Thresholds for Several Photo-Nuclear Reactions by J McElhinney, A O Hanson, R A Becker, R B Duffield and B C Diven Phys Rev 75 542-554 (1949) Feb 1

The x-rays from a 22-Mev betatron were used to observe the thresholds for photo-nuclear (γ,n) reactions which occur when the following are irradiated: H^2, Be^9, Li^7, C^{12}, N^{14}, Mg^{24}, Mg^{25}, Mg^{26}, Al^{27}, Si^{28}, P^{31}, S^{32}, K^{39}, Ca^{40}, Fe^{54}, Cu^{65}, Cu^{63}, Br^{79}, Br^{81}, Sb^{121}, I^{127}, Ta^{181}, Bi^{209}. The observed thresholds are compared with the mass data for the lighter elements and with those obtained from an empirical treatment of the masses for the heavier elements. The excitation curves were extended up to 21 Mev in a few cases. These curves were very much alike except that for the $Ta(\gamma,n)$ reaction. This curve showed an abrupt decrease in slope at about 18 Mev which indicates a much reduced cross section for photons above this energy.

PARTICLE ACCELERATORS

1405 Berkeley Proton Linear Accelerator by Luis W Alvarez, Hugh Bradner, Hayden Gordon, Wolfgang K H Panofsky, Chaim Richman and John R Woodyard. AECU-120 (UCRL-236) Nov 30 1948 120 p (See also MDDC-85, MDDC-1443, MDDC-1445)

A linear accelerator, which increases the energy protons from a 4 Mev Van de Graaff injector, to a final energy of 32.0 $\pm$ .1 Mev, has been constructed. The accelerator consists of a cavity 40 feet long and 39 inches in diameter, excited at resonance in a longitudinal electric mode with a radio-frequency power of about 2.5 x 10^6 watts peak at 202.5 mc. Acceleration is made possible by the introduction of 46 axial "drift tubes" into the cavity, which is designed such that the particles traverse the distance between the centers of successive tubes in one cycle of the rf power. The protons are longitudinally stable as in the synchrotron, and are stabilized transversely by the action of converging fields produced by focusing grids. The electrical cavity is constructed like an inverted airplane fuselage and is supported in a vacuum tank. Power is supplied by 25 high powered oscillators fed from a pulse generator of the artificial transmission line type. Output currents are 4 x 10^{-9} ampere average, and 1 μA peak. The beam has a diameter of 3 mm and an angular divergence of 10^{-3} radians.

1406 The Design of Linear Accelerators by J C Slater. MIT Research Laboratory of Electronics Technical Report No. 47 Sept 2 1947 71p (NP-630) (See also Nuclear Science Abstract No. I-818)

The linear accelerator is compared to other machines for accelerating electrons and positive ions. Among the topics discussed are: the properties of periodically loaded wave guides; Fourrier resolution of the magnetic field, the modulation coefficient, and transit time correction; velocity of energy propogation in the loaded guide; attenuation of the travelling wave in the guide; power input to the guide; geometrical factors affecting efficiency of acceleration; input impedence of a standing-wave and travelling-wave tubes; the special case of the π-mode tube; feeding of power into linear accelerators; power feed from a self-excited oscillator; tolerances in a long accelerator; dynamics of particles in an accelerator; application of electron dynamics to different types of accelerators; and dynamics of transverse motion and focussing.

1407 Orbital Stability in a Proton Synchrotron by N H Frank and R Q Twiss. MIT Research Laboratory of Electronics Technical Report No. 58 Feb 9 1948 28p (NP-632)

The theory of the electron synchrotron has been covered elsewhere, but the proton synchrotron exhibits a number of distinct but important differences particularly at low energies. In the present paper, the theory for this latter accelerator is developed with particular reference to the problems of injection and stability in the initial acceleration period. This theory is then used to set up criteria relating the dimensions of a proton synchrotron to the conditions for stability and to the beam intensities obtainable.

PHYSICS, GENERAL

1408 Heat Transfer Lectures; Volume I compiled by Don Cowen. AECU-116 (NEPA-804) Dec 1948 279p

The following reports, which are included in this volume, are based on lectures given at a symposium on heat transfer sponsored by NEPA at Oak Ridge, Tennessee, December 8-13, 1947: A Summary of the Elements of Heat Transfer, by H. J. Stoever; High Densities of Heat Flux From Metal to Water, by William H. McAdams; Calculations of Conduction, by G. M. Dusinberre; The Measurement of Rapidly Changing Temperatures, by G. A. Hawkins; Prediction of Recovery Factors, by Howard W. Emmons; Pressure Drop in Commercial Exchangers, by Byron E. Short; Exploding a Heat Transfer Myth (Discussion of a laminar film on the wall of a tube), by Benjamin Miller; Heat Transfer From Hot metal to Boiling Water, by R. L. Scorah; Heat Transfer Equipment, by K. W. Coons; Use of Network Analyzers for Solving Thermal and Stress Problems, by F. W. Bubb; Heat Transfer to Granular Materials, by R. L. Pigford; Effect of Solar Radiation on a Body at High Altitudes, by S. M. Marco; Infrared Radiant Heating, by Harold J. Garber.

PHYSICS, GENERAL (continued)

1409 Liquid Vapor Power Cycle by A S Thompson. AECU-135 (NAA-SR-26) Feb 3 1949 21p

The characteristics of liquid-vapor power plants as a function of the working temperatures of the cycle are described. Some specific cases are calculated for a steam cycle to show the results for a substance for which data exist in the form of steam tables. An idealized cycle is discussed and some calculations are made to show how it compares with the actual steam cycle and for use in extrapolating the liquid-vapor cycle efficiencies to higher temperatures and to materials for which no specific data, or insufficient data, on properties exist. It is concluded that liquid-vapor cycles have an advantage in efficiency over gas cycles at the lower temperature ratios. The advantage disappears gradually as the temperature ratio is increased. The liquid-vapor cycles are subject to various practical limitations, having to do with materials and stability of the nuclear process, which may offset the advantage of efficiency.

1410 Transient Phenomena in Waveguides by Manuel Cerrillo. MIT Research Laboratory of Electronics Technical Report No 33 Jan 3 1948 198p (NP-634)

This work deals with the study of the transient phenomena of electromagnetic waves in hollow metallic cylinders of a general geometric cross section when excited under different initial and terminal conditions. A semi-infinite waveguide, the cross-sectional dimensions of which are small in comparison with its length, is excited at one end, taken as the origin, by an electromagnetic field of rather arbitrary waveform. The solution given shows (a) the distortion of the waves in amplitude and frequency as they propagate along the waveguide; (b) the speeds, signal and group velocities, and the time of formation (time in which the internal fields build up) at the given point of observation, or the spatial distribution of the fields at a given instant of time; (c) general methods of solution for complicated waveforms of the incoming signals; and (d) reduction of all transients to a typical one by means of generating functions. Exact, asymptotic, and graphical solutions are given as solutions of the transient behavior, and applications are made to some typical cases. Laplace transformations are used as the basic mathematical tool in this investigation.

PHYSICS, NUCLEAR

1411 Nuclear Physics Survey Course, Chapters 1, 2, 4 and 5 by S deBenedetti and E. P. Blizard AECU-119 (M-3279) nd 58p

The several chapters deal with the following: the classic investigations of Rutherford, Chadwick, Moseley, and others proving the existence and determining the constituent parts of atomic nuclei; the historical background of the mass spectrographic method of investigating nuclear mass (14 references for this chapter); natural radioactivity, decay series, and units for radioactivity; survey of methods and techniques available for measuring radiations from radioactive substances.

1412 Atomic Glossary. Atomes 4 46 (1949) Feb (In French)

This glossary contains definitions of 38 terms commonly occurring in literature on nuclear energy.

PHYSICS, NUCLEAR - METHODS OF MEASURING

1413 A 48-Channel Pulse Height Analyzer for Alpha Energy Measurements by A Ghiorso, A H Jaffey, H P Robinson and B Weissbourd. AECD-2508 (CC-3887) Oct 7 1948 Decl Mar 2 1949 113p For publication in NNES

The pulse from the chamber is amplified in the preamplifier and the first amplifier. It is then passed through a prediscriminator stage, which subtracts the same voltage from each pulse. The remaining portion of each pulse is amplified in the second amplifier, the output of which is a cathode follower. The output stage then feeds into the 48 channels through a subsidiary set of cathode followers. By varying the bias in the prediscriminator and by varying the gain of each amplifier separately, the region of interest can be spread over all the 48 channels. The ability to concentrate all the detectors

PHYSICS, NUCLEAR - METHODS OF MEASURING (continued)

on a small energy region (thus accentuating energy differences) is important, since most of the alpha-emitters of interest have energies between 4 and 6 Mev. Every detector whose bias is less than the pulse size is fired by a pulse, but by means of a cancellation circuit, which is described, the resulting signal is not transmitted to the recorder unless the pulse has not tripped the detector with next higher bias. The counts in each channel are registered by fast mechanical recorders. A photograph of the entire unit is shown. A full description of the equipment and methods of operation is given.

1414 Instructions for Use of A1 Amplifier and Preamplifier by W H Jordan and P R Bell. AECU-128 (MonP-323 Rev.) Feb 15 1949 13p

The A1 linear amplifier is designed for amplifying small pulses from an ionization chamber, proportional counter or similar device, to a level where the pulses can be seen on an oscilloscope and counted with a scaler. A pulse-height selector is included so that only pulses larger than a selected value will be counted. A block diagram of the amplifier is shown. Everything but the counter and preamplifier is included on the main amplifier chassis. The amplifier is provided with a bandwidth switch so that it will be useful for fast counting of large signals or somewhat slower counting of small signals. Detailed information covers the power supply, preamplifiers, video amplifier, pulse-height selector, pulse-shape considerations, extraneous counts (from breakdown of insulators or an external source such as electric typewriters) and overall characteristics (overall sensitivity, and overall gain).

1415 Thin Cobalt Foils by Electroplating for Thermal Neutron Monitoring by O Sisman and C D Bopp. AECU-130 (ORNL-299) nd 4p

Foils from 2 to 4 mils thick (45-90 mg/sq cm) containing not more than 0.1% impurities (including 0.05% Ni) were prepared using a bath similar to that given by W Blum and G R Hagaboom (Principles of Electroplating and Electroforming, McGraw-Hill, 1930, p280). It was found that by plating on glossy stainless steel sheet that had been abraded with a medium fine carborundum cloth, the plate could be easily peeled off when it reached the desired thickness. Plating conditions are specified. Current densities are given. The bath used contained cobalt chloride.

1416 Conference on Scintillation Counters and Crystal Counters by University of Rochester. AECU-137 (M-4281) July 22-23 1948 26p

This document consists of notes summarizing the discussions at this conference. Under scintillation counters brief notes are made concerning phosphors, light conductors, photomultiplier tubes, amplifiers. There are also notes concerning silver chloride, thallium halide, diamond, zinc sulfide, and cadmium sulfide crystal counters, and proportional and parallel plate detectors.

1417 Pulse Generator EL-261 (Instruction Manual) by H Louis Cook Jr. AECU-138 (MLM-271) Dec 31 1948 18p

Performance characteristics, procedure for calibration of output control, circuit description and diagram, photographs, and a parts list are included.

1418 A Calorimeter for the Determination of the Intensity of a Beam of Accelerated Particles by J H Sanders J Sci Instruments 26 36-38 (1949) Feb

The construction of a target which allows the measurement of the energy in a beam of accelerated particles is described. This can be used to deduce the number of particles in the beam. The calorimeter is useful in cases where the charge collected is not a significant measure of this quantity. The accuracy obtainable is better than 2%, and the power handling capacity 25 w. The latter is capable of extension over a wide range.

PHYSICS, NUCLEAR - METHODS OF MEASURING (continued)

1419 The Chi-Square Test as a Criterion for Testing Halogen-Filled Geiger Tubes by A B Willoughby. Naval Radiological Defense Laboratory Report ADP-60 Dec 23 1948 15p

Among the many problems of producing large numbers of radiac instruments for use by the Navy in atomic warfare defense is the provision of suitable standards upon which to accept or reject Geiger tubes as they are manufactured. In the past the maximum acceptable plateau slope for organic-quenched Geiger tubes has been about 5 per cent. The recently developed halogen-quenched tubes have an inherent slope of about 6 per cent or more. Since the latter tubes appear to have an infinite counting lifetime, it was decided to re-examine the criterion for acceptance of tubes. As a basis for a new criterion, use will be made of the fact that if a good Geiger tube is used to count a fixed source several times, the resulting set of numbers form a Poisson distribution. It is proposed that all tubes be statistically tested using the Chi-Square Test to see whether they give this Poisson distribution. If they do, then they are accepted. In applying this test at various points along the plateau slope of a number of halogen-quenched tubes. It was found that the tubes passed the test for quite high values of ρ(at least $\rho = 1.4$), where ρ is defined as the ratio of the counting rate at any voltage, E, to the counting rate at threshold. A Geiger tube which passes the Chi-Square test at the highest operating voltage was found to pass it at any lower voltage. Thus the proposed criterion for accepting a halogen-quenched Geiger tube reduced to whether or not it passes the Chi-Square test at its highest operating voltage.

1420 Luminescent Solids (Phosphors) by H W Leverenz Science 109 183-195 (1949) Feb 25

The theory of luminescence and the production and composition of commonly used luminescent materials, such as the phosphors which are finding increasing scientific use in detecting ultraviolet and x-ray photons, α-particles, infrared and γ-ray photons, fast-moving ions, and even neutrons, are discussed. The detection is accomplished by converting the energies of the former into radiations which the human eye may detect directly, or indirectly, through other photosensitive devices (such as multiplier phototubes, usually coupled with osciloscopes or meters, photographic films, or other phosphors used in cascade.)

1421 Power Supply for an X-Ray Tube Used in Conjunction with a Geiger Counter Spectrometer by U W Arndt J Sci Instruments 26 45-47 (1949) Feb

The special requirements for power supplies feeding x-ray tubes used in conjunction with Geiger-Muller counting equipment are discussed. The counting losses at high counting rates for the different types of ht supplies are compared, and an electronic stabilizing circuit is described.

1422 Quantitative Measurements with Scintillation Counters by Hartmut Kallmann Phys Rev 75 623-626 (1949) Feb 15

The efficiency of a number of fluorescent materials used as scintillation counters for various materials has been measured. Two characteristics have been distinguished: (a) The physical light yield, i.e., the fraction of the absorbed energy transformed into light, and (b) the practical light yield, i.e., the amount of light obtained from a given intensity of radiation of a particular type, with the thickness of the phosphor adjusted for optimum results. Although the sulfide phosphors are high in physical yield, their practical yield is relatively lower because they are quite opaque to their fluorescent radiations. The organic phosphors, such as naphthalene and phenanthrene, and the potassium bromide phosphors are very much better in this respect. The author notes that since the writing of this paper, better cadmium sulfide crystals have been developed which give nearly homogeneous flashes for monoenergetic α-particles.

PHYSICS, NUCLEAR - METHODS OF MEASURING (continued)

1423 Radiation Detector by K C Crumrine, assignor to the Texas Co, New York, N Y US Patent No. 2,462,471 (1949) Feb 22

A device is described for detecting neutron radiation; essentially it is comprised of a block of lead (cathode) provided with several holes, along the axes of which wires are disposed (anodes); in the spaces between the anodes and the cathode block a substance is interposed capable of emitting α-rays when bombarded by neutrons.

1424 Removal of the Background-Traces of Charged Particles in Emulsions by the Method of Accelerated Photo-Regression by G E Belovitskii and L V Sukhov Doklady Akad Nauk SSSR 61 243 (1948) July 11 (In Russian)

Increased temperature and humidity were found by the authors to accelerate the disappearance of images produced by α-particles and protons on a photographic plate. These findings were utilized for the removal of background traces from an emulsion without impairing the latter's sensitivity. The authors state the present work was accomplished before the publication of similar results by Yagoda and Kaplan (Phys Rev 73 639 (1948)).

1425 A Study on a Contaminated Cloud Chamber by K Sitte Casopis pro Pestovani Matematiky a Fysiky 73 No. 1, 31-40 (1948) (In English)

Experiments on a cloud chamber, which has been contaminated since Rutherford's time with radioactive substances, have been made. An electric cleaning field was used for the removal of ionization products and its effect on the number of α-particles and ions was investigated. The presence of an appreciable number of α's was found to effect a decrease in the visibility of electron tracks. The experimental and theoretical aspects of this phenomenon were investigated and it was concluded that the probable explanation may be found in the condensation heat of the vapor given off along the α-tracks. This would cause an adiabatic pressure rise in the chamber beyond the value at which track formation is still possible.

PHYSICS, THEORETICAL

1426 Classical Electrodynamics without Singularities by H McManus Proc Roy Soc London 195 A 323-336 (1948) Dec 22

It is shown that it is possible to construct a theory of the electron with an extended charge distribution in a Lorentz invariant way by introducing a 4-dimensional form function. The electromagnetic field quantities reduce to those given by the ordinary theory at distances large compared with the electron radius r_0, but remain finite on the world line. The equations of motion, after elimination of the self field, become integro-differential equations. In the case of small accelerations an expansion in powers of r_0 similar to that of Lorentz is obtained, in which only odd powers of r_0 occur. The first term endows the electron with a mass component of electromagnetic origin. For accelerations small compared with the characteristic frequency $1/r_0$ of the electron, the Lorentz-Dirac equations are a good approximation; for larger accelerations, higher terms become important.

1427 Co-ordinate Operators in Quantum Mechanics by H T Flint Nature 163 131-132 (1949) Jan 22

The fact that the orbital angular momentum operators do not completely describe the angular momentum of a fundamental particle but require also the expression for the spin suggests that the use of co-ordinate operators in quantum theory will also require the addition of an analogous expression. The group of angular momentum and co-ordinate operators can be regarded as forming a single tensor (Proc Roy Soc London 185 A 22 (1945)); and from this fact it is suggested that the co-ordinate should be extended in a particular form. The result obtained is interesting because it introduces into quantum mechanics a relation which corresponds to the familiar definition of "momentum = mass x velocity." The expressions obtained lead the author to conclude that a solution of certain difficulties, which

PHYSICS, THEORETICAL (continued)

appear to indicate the necessity of a quantized space-time, is to be found, not in an intrinsic property of the space of physics, which possibly has no properties except those given to it by the geometer, but in an intrinsic property of matter.

1428 Electromagnetic Self-Energy of Protons and Neutrons by L A Radicati Nuovo Cimento 5 513-514 (1948) Oct (In Italian) (Letter to the editor)

The process λ suggested by Dirac for the elimination of divergencies in the theory of the electron (Annales de l'Institut Pasteur 9 13 (1939)) is applied to the case of electromagnetic self-energies of particles with an anomalous magnetic moment. The method permits the elimination of all divergencies relative to the supplementary magnetic moment, whether connected with longitudinal waves, or depending on the transversal component of the electromagnetic field. For the elimination of these latter divergencies it is not necessary to proceed to a new quantization of the field, as suggested by Dirac.

1429 Non-Linear Field Theories by Peter G Bergmann Phys Rev 75 680-685 (1949) Feb 15

This is the first paper in a program concerned with the quantization of field theories which are covariant with respect to general coordinate transformations, like the general theory of relativity. All these theories share the property that the existence and form of the equations of motion is a direct consequence of the covariant character of the equations. It is hoped that in the quantization of theories of this type some of the divergences which are ordinarily encountered in quantum field theories can be avoided. The present paper lays the classical foundation for this program: it examines the formal properties of covariant field equations, derives the form of the conservation laws, the form of the equations of motion, and the properties of the canonical momentum components which can be introduced.

1430 On the Relativistic Invariance of Quantized Field Theories by J S de Wet Proc Roy Soc London 195 A 365-376 (1948) Dec 22

Heisenberg and Pauli (Z Physik 56 1 (1929)) have shown how to quantize field theories derived from Lagragians containing first-order derivatives of the field quantities. They showed their quantization to be Lorentz invariant. Fuchs (Proc Roy Soc Edinburgh 59 109 (1939)) subsequently showed that the quantized theory was in fact invariant under general transformations of co-ordinates. The present author in another paper (Proc Cambridge Phil Soc (in press) (1948)) has shown how the theory of Heisenberg and Pauli can be extended to field equations derived from higher order Lagragians, i.e. Lagragians containing higher derivatives than the first of the field quantities. In the present paper the general relativistic invariance of the higher order quantized theories is established, making use of the generalized Poisson brackets introduced by Weiss (Proc Roy Soc 169 A 102 (1938)).

1431 On the Theory of Para- and Ortho-States of Elementary Particles by D Ivanenko and A Sokolov Doklady Akad Nauk SSSR 61 51-54 (1948) July 1 (In Russian)

According to the authors' views (Vestnik Moskovskogo Univ No. 6 3 (1947)) the collision between a free electron and a free positron may result, apart from annihilation, in the formation of a metastable system, a "positronium," consisting of two particles revolving around the common center of gravity. If the two spins are parallel, the system formed is an ortho-positronium, while the case of two antiparallel spins corresponds to a para-positronium. Since the lifetime of a positronium must depend on the system's spin, the question arises as to the behavior of ortho- and para-systems consisting of free particles, i.e., a free electron and a free positron. The difficult problem of the annihilation of a positronium can be reduced to that of the annihilation of free particles, inasmuch as the binding energy of a positronium is small in comparison with the total energy of an electron or a positron. The problem can be solved by using a convenient way of writing Dirac's equation as suggested by Sokolov (J Physics USSR 9 363 (1945)) and by Kan (Doklady Akad Nauk SSSR 50 139 (1945)). For the case of a two-photon

PHYSICS, THEORETICAL (continued)

annihilation of a free electron-positron system, a formula for the effective cross section is obtained which reveals the important fact that for the ortho-state the annihilation probability is equal to zero, while for the para-state this probability is twice as large as the value given by Dirac for the case when the two spins have an arbitrary orientation. From these data the corresponding values for the positronia are derived (zero for the ortho-system). The lifetime of an ortho-positronium can be determined by first computing the effective cross section of a three-photon annihilation of a free system. It is found that for an ortho-system this cross section is roughly 1/137 that obtained for the two-photon annihilation of a para-system. Neglecting the relativistic effects, the ratio of the lifetimes of ortho- and para-positronia is then found to be 1.7 x 103. This same reasoning can, of course, be applied to ortho- and para-systems of other particles.

1432 Phase Velocity and Group Velocity by N Carrara Nuovo Cimento 5 515-516 (1948) Oct (In Italian) (Letter to the editor)

The theory of the Michelson-Morley experiment was submitted to a critical study recently by Ditchbubn (Rev Optique Theor 27 4 (1948)). Let V be the phase velocity of light, U its group velocity, and c a constant introduced from the restricted relativity theory. The Michelson-Morley experiment does not prove that V and U equal c, but it proves that $VU = c^2$. Furthermore, this same equation is valid for the de Broglie waves. Every radiation being characterized by V, U, λ (wavelength), and ν (frequency), the present author studies the relationship between these magnitudes on the basis of the restricted relativity theory, and the experimental conditions necessary for their determination. One of the results is a general formula for the refractive index $n = \sqrt{1 - K/\nu^2}$, where K is a constant. K = 0 for light in vacuum; $K = h/mc^2$ for de Broglie waves; still different expressions for K correspond to high frequency waves and to waves in the ionosphere.

PUMPS

1433 Design of Small Centrifugal Blowers by Judson S Swearingen. AECD-2487 June 10 1946 Decl Feb 15 1949 12p Proposed for publication in Chem Inds

A summary of design development is given; the principles disclosed are recommended as being equally applicable to larger pumps. The discussion covers impellers vaneless diffusers, vaned diffusers, and collectors.

RADIATION SICKNESS

1434 Studies of the Effects of Flavonoids in Roentgen Irradiation Disease. II. Comparison of the Protective Influence of Some Flavonoids and Vitamin C in Dogs by John B Field and Paul E Rekers. AECU-149 (UR-57) Jan 19 1949 18p

Given 350r single dose total body x-irradiation, 60 per cent (22 of 37) untreated control dogs succumbed with a prominent hemorrhagic diathesis. Five flavanone substances appeared roughly of equal activity in reducing the hemorrhagic signs of the irradiation disease when administered continuously pre- and post-radiation. Given rutin, 11 per cent (3 of 27) of the dogs succumbed; with hesperidin, 16 per cent (1 of 6), with epimerized d-catechin, 10 per cent (1 of 10). With homoeriodictyol, none of 5, and with morin, none of 6 irradiated dogs succumbed. Other flavonoids and their derivatives did not significantly reduce either the mortality or hemorrhagic changes in irradiated dogs. These included hesperidin methyl chalcone, esculin, quercitin, quercitrin, and naringin. With the benzopyrone, coumarin, 33 per cent (2 of 6) of the dogs succumbed suggesting slight anti-irradiation activity.

Ascorbic acid alone failed to influence the course of irradiation disease and 50 per cent (3 of 6) of treated dogs died. However, when ascorbic acid was given simultaneously with quercitin which by itself was ineffective, (50 per cent mortality) only 10 per cent (1 of 10) dogs succumbed exhibiting reduced signs of the disease. No increase in protective activity occurred when ascorbic acid and hesperidin methyl chalcone were given together. It is suggested that previous misunderstanding of

RADIATION SICKNESS (continued)

the nature of "vitamin P" has arisen from both the failure to recognize that several flavanones possess very similar anti-hemorrhagic "activity" and that ascorbic acid has the capacity to potentiate "activity" in other flavanones. Potent hyaluronidase inhibitors as dopa and sodium gentisate failed to influence the course of irradiation disease in dogs. It is suggested that the "spreading factor," hyaluronidase, plays little or no role in the evolution of this disorder.

RADIOACTIVITY

1435 The Beta Spectrum of A^{41} by H Brown and V Perez-Mendez. AECD-2490 (CUD-19) Feb 1 1949 Decl Feb 25 1949 5p Proposed for publication in Phys Rev

A beta-ray spectrometer of the magnetic semicircular focusing-type has been constructed for the investigation of the spectra of radioactive gases. It was used together with a source consisting of a gas in a container to obtain the beta spectrum of A^{41} down to 150 kev. The A^{41} was produced by bombardment of A^{40} in the cyclotron, using a gas probe for the purpose. The spectrum has an extrapolated end-point of 1240 Kev and is of the shape predicted by the Fermi theory of allowed spectra.

1436 Half-Life of Thorium-227 (Radio-Actinium) by S Peterson and A Ghiorso. AECD-2501 (ANL-HDY-602) Nov 1 1948 Decl Mar 3 1949 2p For publication in NNES

A procedure is given for the separation of Th^{227} and long-lived Th^{230} from radium isotopes (daughter activities of thorium disintegration). Subsequently the decay of the two Th isotopes is followed by means of a multi-channel differential pulse analyzer, and the ratio of the two half-lives established. The half-life of Th^{227} is given as 18.6 ± 0.1 days.

1437 The Beta Ray Spectra of Cu^{64} and the Ratio of N^+/N^- by C S Wu and R D Albert. AECD-2504 (CUD-20) Feb 8 1949 Decl Feb 25 1949 7p Proposed for publication in Phys Rev (See also AECD-2403)

The previously reported Cu^{64} spectra obtained by using Columbia's helical focussing spectrometer have been replotted according to the revised correction factors of the screening and relativistic effects. The deviations of both positrons and negatrons at low energies are exceedingly small and both behave in similar manner. The experimental ratios of positrons to negatrons agree with the theoretical values predicted from Fermi theory.

1438 Beta-Particle-Orbital Electron Capture Branching and "Missing" Beta Stable Isotopes by Geoffrey Wilkinson. AECU-123 (UCRL-289) Feb 14 1948 9p

A consideration of hard negative electrons emitted by several radioactive isotopes of the heavier elements of odd atomic number and even mass number, has led to the conclusion that negative beta-particle-orbital electron capture branching occurs in these isotopes. This in turn has led to the postulation of unreported beta-stable isotopes of several elements of even atomic number. Detection of beta-stable, possibly α-active isotopes of the even Z elements, is possible by either (a) separation of light fractions by the usual methods of isotopes separation, with detection by radioactivity measurement or by mass spectrometry—this method would be particularly feasible for tungsten, which has a volatile fluoride, or (b) bombardments of odd Z elements with high energy protons or deuterons—the most profitable cases from the experimental point of view are those of tantalum, iridium, gold, and europium.

1439 Report on Trip to Chalk River, February 7-11, 1949 by M E Rose. AECU-125 (ORNL-306) nd 5p

The preliminary part of the discussion is devoted to a description of the work done by the author on K-shell internal conversion coefficients. Inasmuch as the value of the above-mentioned work to experimentalists is greatly enhanced if the values of the internal conversion coefficients for the L-shell are also known, the primary subject of the remainder of the discussion is devoted to the question

RADIOACTIVITY (continued)

of procedures most suitable for obtaining the L-shell internal conversion coefficients. For these it is necessary to take into account the screening of the ejected electrons due to the presence of all the other atomic electrons. This effect of screening could be omitted from the K-shell calculations because reliable estimates can be made which show that its omission cannot cause an error greater than 2% and for several reasons this represents a limit of accuracy of the calculations which have been undertaken. It was agreed that the only method available for calculation with screening would be first to calculate screened wave functions for the atomic electrons and then to obtain internal conversion coefficients from these by numerical integration. A program for carrying on the work between the interested groups was planned.

1440 The Nuclear β-Spectra of Thorium B $\rightarrow$C and C $\rightarrow$C′, and the Intensities of Some β-Ray Lines of Thorium (B + C + C″) by D G E Martin and H O W Richardson Proc Roy Soc London 195 A 287-300 (1948) Dec 22

The β-spectra of Th(C + C″) and Th(B + C + C″) have been measured using semicircular focusing. To prevent the escape of ThC″ by α-recoil, the sources were mounted between 2 thin films. The intensities of 7 of the γ-ray lines were measured and the continuous spectra of ThB.C and ThC.C′ were found by subtraction using the known spectrum of ThC″.D. The β-ray end-point of ThC.C′ is at 2.250 Mev, and the shape of the β-ray spectrum differs but little from that of an allowed transition for energies above 0.9 Mev. A detailed comparison is made with the shape of the compound spectrum required to account for the known γ-rays of ThC′, using the theory of forbidden transitions. A spin change of $\Delta I = \pm 2$ is ruled out, but $\Delta I = 0$ or ± 1 is possible. The β-spectrum of ThB seems to be composite with its principal end-points at 0.331 and 0.569 Mev and the intensity of the high-energy transition between the ground states is about 0.12 ± 0.02 electrons per disintegration. The K internal conversion coefficient of the F γ-ray was found to be about 0.377, 16% higher than the theoretical value for magnetic dipole radiation. 21 references 8 figures.

1441 The Radioactivities of Some High Mass Isotopes of Cobalt by Thomas J Parmley, Burton J Moyer and Robert C Lilly Phys Rev 75 619-623 (1949) Feb 15 (See also MDDC-859, -1089 and -1190)

By neutron bombardments of samples of Ni enriched in isotopes 61, 62, and 64, respectively, the following radioactivities have been identified:

Co^{61}, β^- 1.3 Mev, no γ, half-life 1.75 hours,

Co^{62}, β^- 2.3 Mev, γ1.3 Mev, half-life 13.9 min.

Evidence is also presented for a 1.6-minute β- and γ-activity associated with Co^{62} and for a 4- to 5-minute activity possibly associated with Co^{64}.

RADIOTHERAPY

1442 Beta Radiation Therapy by A D Ruedmann Arch Ophthalmology 41 1.4 (1949) Jan

The value of radiation is stressed because of its usefulness in treatment of so many conditions previously supposed to be incurable. Use of roentgen, γ- or β-radiation offers a valuable therapeutic adjunct in ophthalmology. To date, there has been no definite evidence of injury to the eye with β-radiation. In several cases of severe corneal leukoma, excessive treatment with β-radiation produced small perforating ulcers and enucleation was necessary. Roentgen and γ-radiation therapy may produce cataract and injure the retina permanently. It is possible to use the various forms of radiation in a single case. Care must be taken to allow for subsidence of reaction if such a procedure is indicated.

RADIOTHERAPY (continued)

1443 Dangers of Irradiation of Hypertrophied Lymphoid Tissue of the Nasopharynx by Milford D Schulz and Laurence L Robbins Trans Amer Acad Ophthalmol and Otolaryngology 243-252 (1949) Jan-Feb

Eleven cases are cited to demonstrate the dangers that are involved in irradiation. Emphasis is placed on the facts that degenerative changes may not appear for many years and that multiple doses are probably more hazardous than a single application.

1444 Effect of Roentgenotherapy on Urinary 17-Ketosteroid Excretion in Ankylosing Spondylarthritis by Roland A Davison, Peter Koets and William C Kuzell J Clin Endrocinol 9 79-88 (1949) Jan

Urinary 17-ketosteroid excretion was found to be increased in spondylarthritis of the ankylosing type in both male and female patients. High values continued for long periods of time and approached lower levels only when the patient reached a state of exhaustion. Roentgenotherapy seemed to provide a stimulus for increased excretion followed by a relative decrease. Following the roentgenotherapy the values returned to high levels although the symptoms and signs of the disease had abated.

1445 Irradiating Effect of Methyl Bis (B-Chloroethyl) Amine Hydrochloride by R deR Barondes and Clinton Lyons Military Surgeon 104 138 (1949) Feb

A study of the effect of nitrogen mustard on supersensitive photographic film showed that this agent emits a spectrum affecting the film. The wavelength has not been determined. The authors deduce that the systemic effect caused by the nitrogen mustards is one of internal radiation. Further work is in progress to determine if similar acting agents, e.g., mustard oil, urethane, stilbamidine, arsenic, bismuth, and others may not supplement or substitute for radium roentgen, and other forms of radiotherapy.

1446 The Use of Radioactive Isotopes in Clinical Medicine by John Z Bowers Delaware State Med J 21 25-27 (1949) Feb

The results of exposure to an atomic bomb explosion and the therapeutic effects of radioactive isotopes are briefly described. Two and one-half pages of discussion follow.

RARE EARTHS AND RARE EARTH COMPOUNDS

1447 Separation of Actinium from Rare Earths Using IR-1 Resin by C K McLane and S Peterson. AECD-2498 (ANL-JJK-14B-167) Dec 1948 Decl Mar 3 1949 7p For publication in NNES

Almost complete separation of tracer quantities of actinium and lanthanum was obtained by eluting the adsorbed mixture from IR-1 cation exchange resin with a 0.25 M citrate solution of pH near 3. To separate actinium from larger quantities of lanthanum the exchange column must be sufficiently large to absorb the mixture on a small fraction of the resin bed. A column 1.1 cm in diameter and 55 cm long is sufficient for 0.20 g La.

1448 Extraction of Cerium (IV) Nitrate by Butyl Phosphate by J C Warf. AECD-2524 (ISC-8) Aug 7 1947 Decl Mar 11 1949 12p

Cerium (IV) nitrate is readily extracted from aqueous solutions by tri-n-butyl phosphate, a solvent which is reasonably stable under the strongly oxidizing conditions. The conditions for extraction are not critical, and favorable extraction is not inhibited by perchlorates or acetates, but sulfates interfere. By oxidation with bromates and simultaneous exhaustive extraction by butyl phosphate, the cerium may be quantitatively extracted. The degree of separation of cerium from iron, zirconium, lanthanum, and praseodymium are discussed. Uranium and thorium are extracted by butyl phosphate; the first is easily removed beforehand, and the second may be separated by coprecipitation of ceric iodate. It is believed that cerium (IV) nitrate is extracted by butyl phosphate by virtue of the formation of a new complex. Some attempts were made to identify or characterize this new body, but no conclusive evidence was gained.

RARE EARTHS AND RARE EARTH COMPOUNDS (continued)

1449 Radioactive Isotopes of the Rare Earth Elements II. Neodymium Isotopes by Geoffrey Wilkinson and Harry G Hicks. AECU-122 (UCRL-276) Jan 20 1949 14p

The techniques of study of radioactive isotopes of the rare earth elements described previously (AECU-81 (URCL-253)) have been applied to neodymium. Using the 60-inch Crocker Laboratory cyclotron, bombardments have been made of praseodymium with 19 and 9 Mev deuterons and 10 Mev protons. The characteristics of the neodymium isotopes are given in the table.

Isotope	Type of Radiation	Half-life	Energy in Radiation in Mev		Produced by
			Particles	γ-rays	
Nd^{140}	K	3.3 ± 0.1 days		K x-rays ~ 1.2 (weak)	Pr-d-3n
Nd^{141}	K, β^+ (2%), γ	145 ± 3 min	0.7 (β^+)	K x-rays 1.05	Pr-d-2n Pr-p-n

SCIENTIFIC RESEARCH AND LABORATORIES

1450 Problems in Planning Facilities for Radiochemical Process Development by A C Jealous. AECD-2512 Feb 1949 Decl Feb 25 1949 29p

An abstract of this document was assigned the number AECD-2450 and appeared in Nuclear Science Abstracts as abstract No. II-1016.

1451 A Radiation Shield Block by J O Billups. AECU-134 (NAA-SR-25) Feb 1 1949 15p

An interlocking block design is described. The vertically interlocking surface is adaptable to straight runs, turning corners or unsupported slabs. The horizontal keying surface is adaptable to wall structures of varying heights or slabs of varying widths. The combination allows complete enclosures. Photographs of a single cavity chill mold for manufacturing the block, and of several block combinations are included. The block can be made of a plastic material impregnated with radiation absorbents, or of sheet steel which can be filled with absorbent and sealed.

1452 Atomic Energy in Medicine by John Z Bowers Diplomate 21 39-46 (1949) Feb

The activities of the division of biology and medicine of the Atomic Energy Commission are presented briefly along with a more detailed account of the effects on human beings of an atomic explosion.

SPECTROGRAPHY

1453 Resonance Transfer of Electronic Energy in Organic Crystals by E J Bowen, E Mikiewicz and F W Smith Proc Phys Soc 62A 26-31 (1949) Jan 1

The resonance transfer of energy in crystals of organic compounds when excited by visible or ultra-violet light has been examined by measuring the fluorescence of the systems naphthalene-anthracene, anthracene-naphthacene, naphthacene-pentacene, anthracene-acridine, anthracene-phenazine, and anthracene-di- and hexabromobenzenes. The conditions for "exciton" trapping and the relations of resonance transfer to fluorescence quenching are discussed.

1454 The Vibration Spectra of the Alkali Halides by R S Krishnan and P S Narayanan Proc Indian Acad Sci 28 A 296-306 (1948) Nov

The physical basis for the derivation of the result that any crystal has only 24p-3 normal modes of atomic vibration, p being the number of non-equivalent atoms in the unit cell, has been briefly reviewed. The difficulties connected with the successful recording and interpretation of the spectra of the alkali halides have been pointed out. The Raman spectrum of potassium bromide excited by γ 2536.5 radiation has been recorded, using both moderate and high dispersion spectrographs. It

SPECTROGRAPHY (continued)

exhibits a series of sharp Raman lines, 11 of which could be easily identified. The 5 most intense lines which stand out prominently in the spectrum on account of their extreme sharpness have frequency shifts 84, 126, 146, 170, and 216 cm^{-1}. The numerical evaluation of the 9 eigenfrequencies for KBr on the basis of the new lattice dynamics leads to results in good agreement with observational data. Their activities in light-scattering and infra-red absorption are also discussed. The vibrations which are most active in Raman effect are those in which the Br ions lying in the octahedral layers alone move. This result is in general agreement with the observed facts.

TRACER APPLICATIONS - BIOLOGY

1455 Studies on the Surface Chemistry of Bone, I. Recrystallization by W F Neuman and B J Mulryan. AECU-132 (UR-55) Jan 13 1949 18p

The behavior of powdered, fresh rabbit bone when suspended in phosphate buffer containing P^{32} has been studied. In solutions of constant composition the bone mineral was found to undergo a rapid recrystallization. Among the topics discussed are: comparison of the amounts of exchangeable phosphate of bone taken from different parts of the femur, a comparison of exchangeable phosphate of fresh and ashed bone as a function of time, effect of temperature on exchange of phosphate by fresh bone, lack of reversibility of the fresh-bone-buffer system, and specific activity-time relationships.

1456 The Use of Isotopic Carbon in a Study of the Metabolism of Anthranilic Acid in Neurospora by Joseph F Nyc, Herschel K Mitchell, Edgar Leifer and Wright H Langham. AECU-136 (AD-20) nd 7p

Anthranilic acid containing C^{14} in the side chain was given to a Neurospora mutant form which required either anthranilic acid, indole, or tryptophane as a supplement for growth. Nicotinic acid and tryptophane isolated from the mold tissue were found to contain no detectable quantity of isotopic carbon. A large part of the isotopic carbon was accounted for in the carbon dioxide evolved during the growth of the mold. The radioactivity remaining in the tissue appeared to find its way into many substances.

1457 The Fate of C^{14} in the Tissues of Mice after Administration of C^{14} Methyl-Labeled Glycine by George L Nardi. AECU-141 (UCRL-257) Jan 6 1949 22p

1.08×10^6 counts/min as methyl-labeled (C^{14}) glycine were injected intravenously into mature, A strain, male mice. The animals were sacrificed at 6-hour to 43-day intervals. Determinations of activity of excretions, tissues, and carcass were made. Turnover rates of C^{14} were determined. From 20-70% of the injected activity was found in the exhaled CO_2 of the first 24 hours. About 1-3% of the injected activity appeared in the first 24-hour urine. About 10% of the activity appeared in the first 24-hour feces. Relatively small increments were added to these excretions in ensuing time intervals. All tissues showed a steady and progressive loss of specific and total activities. The former were quite similar for all tissues at identical time intervals. Turnover rates revealed very similar values for all tissues. Brain was the slowest; bone was as rapid as liver, pancreas, and heart. The turnover rate of the whole body after 43 days was similar to that of the individual tissues. 5.54% of the injected activity was present with a biological half-time of 10.5 days.

1458 Carbamates in the Chemotherapy of Leucemia IV. The Distribution of Radioactivity in Tissues of Mice Following Injection of Carbonyl-Labeled Urethane by Carl E Bryan, Howard E Skipper and Locke White Jr. J Biol Chem 177 941-950 (1949) Feb

On intraperitoneal injection, urethane begins to break down almost immediately, with the labeled carbonyl carbon being excreted largely as expired carbon dioxide. In normal mice usually greater than 90% of this atom from urethane can be accounted for in the respiratory carbon dioxide within 24 hours. About 5 to 10% of the total activity was found in the urine.

A small fraction of the active carbon from carbonyl-labeled urethane is present in all tissues at 24 and 48 hours after injection. In experiments to date, blood serum has been found to contain more

TRACER APPLICATIONS - BIOLOGY (continued)

active carbon than blood cells. Whole blood, liver, intestines, and tumor tissues have been in a number of cases somewhat high in activity as compared to other tissues. Two mice with advanced spontaneous lymphoid leucemia and 2 with mammary carcinoma have been found to retain much more radioactive carbon from active urethane in all tissues than have normal mice 24 hours after injection.

1459 The Distribution of Fixed Radioactive Carbon in Glucose from Rat Liver Glycogen by Walton W Shreeve, George H Feil, Victor Lorber and Harland G Wood J Biol Chem 177 679-682 (1949) Feb

Glucose isolated from rat liver glycogen after the administration of $NaHC^{14}O_3$ contains the isotope predominantly in carbons 3 and 4. A trace of isotope, however, amounting to about 1 to 2% of that found in the 2 center carbons, occurs in the other positions in the glucose molecule. Some possible explanations for this finding are advanced.

1460 Incorporation of Isotopic Carbon Dioxide in Rabbit Liver Glycogen in Vitro by A Baird Hastings, A K Solomon, Christrian B Anfinsen, R Gordon Gould and I N Rosenberg J Biol Chem 177 717-726 (1949) Feb

Glycogen formation and $C^{14}O_2$ incorporation have been studied in rabbit liver slices in vitro, with pyruvate as substrate and with variations in sodium and potassium concentrations in the incubating media. The incorporation of CO_2 averaged about 8% in the liver glycogen of fasted animals. It was less in well fed animals, or when glucose was substituted for pyruvate as substrate. Potassium ions favored glycogenesis and sodium ions glycogenolysis. The amount of glycogen formed during incubation and the extent of CO_2 incorporation in glycogen was usually greater when both ions were present in equimolecular proportions than when each was present alone.

1461 Interaction of Calcium, Phosphorus, and Vitamin D. III. Study of Mode of Action of Vitamin D using Ca^{45} by B B Migicovsky and A R G Emslie Arch Biochem 20 325-330 (1949) Feb

Experiments on excretion of calcium and phosphorus by starving chicks indicate that vitamin D decreases the loss of calcium via the excreta, and has little effect on the phosphorus. Calcium ingestion decreases the loss of phosphate. When chicks which were previously fed radioactive calcium were used, vitamin D decreased the specific activity of the excreta calcium, indicating a retention of calcium in a tissue of high specific activity, namely, newly formed bone.

1462 Metabolism of Isotopic Pyruvate and Acetate in Rabbit Liver Slices in Vitro by R Gordon Gould, A Baird Hastings, Christian B Anfinsen, I N Rosenberg, A K Solomon and Yale J Topper J Biol Chem 177 727-731 (1949) Feb

Carboxyl-labeled acetate and α-carbon-labeled pyruvate were prepared from C^{14}. A comparison was made of isotopic carbon incorporation in rabbit liver glycogen in vitro in the presence of (a) $C^{14}O_2$, (b) isotopic carboxyl acetate, and (c) isotopic α-carbon pyruvate. Evidence is presented that pyruvate molecules are equilibrated with CO_2 far more rapidly than they are converted to glycogen in the liver of unfasted rabbits, and that acetate molecules may participate in the synthesis of glycogen in vitro without previous combustion to CO_2.

1463 Oxidation-Coupled Incorporation of Inorganic Radiophosphate into Phospholipide and Nucleic Acid in a Cell-Free System by Morris Friedkin and Albert L Lehninger J Biol Chem 177 (1949) Feb

In a washed cell-free suspension of the particulate material of rat liver, consisting largely of nuclei and mitochondria, oxidation of L-malate over the Krebs tricarboxylic acid cycle in the presence of inorganic phosphate labeled with P^{32}, adenine nucleotide, and Mg^{++} leads to incorporation of P^{32} into fractions of the particulate material corresponding to phospholipides, pentose nucleic acid, and an unidentified residue of "phosphoprotein." Incorporation into the desoxypentose nucleic acid

TRACER APPLICATIONS - BIOLOGY (continued)

fraction was negligible. In the absence of active oxidation and phosphorylation of the adenylic acid system there was little or no incorporation into any fraction. The rate of incorporation of the P^{32} into the acid-insoluble esters was much lower than into the acid-soluble fraction, as is known to be the case in intact tissues. 6 tables 21 references.

1464 Rate of Elimination of Radioactive Carbon Administered as Carbonate from the Tissues and Tissue Components of Mature and Growing Rats by Jack Schubert and W D Armstrong J Biol Chem 177 521-527 (1949) Feb

Eight mature rats and 6 growing rats were given intraperitoneal injections of C^{14}-labeled sodium carbonate in order to study the change in C^{14} concentration of the soft and calcified tissues and derived components with time. The rats were killed in pairs at different time intervals from 8 to 30 days after the last of the injections. In general the specific activity of C^{14} in the tissues and tissue components of the growing rats greatly exceeded those of the mature animals. The overall retention of C^{14}, however, was greater in the mature rats. In the latter practically no change in the overall C^{14} retention was observed after the 15th day, while an appreciable decrease in overall retention of C^{14} was observed in the growing animals. Beyond the 8th day the biological half lives of the C^{14} in intact and inorganic bone were 12 to 15 days in the growing rats and 30 to 40 days in the mature rat. In the case of the serum proteins the specific activity of C^{14} and the rates of decrease in C^{14} content were about the same for the 2 groups of rats. The rate of decrease of C^{14} in the soft tissues of the mature rats had decreased appreciably by the 20th day. No significant turnover of C^{14} in the brain protein was observed in the young animals following its incorporation.

1465 A Study of Transmethylation with Methionine Containing Deuterium and C^{14} in the Methyl Group by Elizabeth B Keller, Julain R Rachele and Vincent du Vigneaud J Biol Chem 177 733-738 (1949) Feb (See also Nuclear Science Abstract No. I-1052)

L-Methionine with the methyl group labeled with C^{14} and deuterium was fed to a rat for 4 days. The choline and creatine were isolated from the body of the rat and analyzed for both isotopes. Within the limits of experimental error, the ratio of deuterium to C^{14} in the methyl groups of the choline and creatine was found to be the same as it was in the methyl group of the dietary methionine.

1466 A Synthesis of Isotopic Cytosine and A Study of Its Metabolism in the Rat by Aaron Bendich, Helen Getler and George Bosworth Brown J Biol Chem 177 565-569 (1949) Feb

A synthesis of cytosine, containing an excess of isotopic nitrogen in positions 1 and 3, from urea and cyanoacetaldehyde diethyl acetal is described. Evidence is presented that dietary cytosine does not serve as a specific metabolic precursor of nucleic acid nitrogen.

TRACER APPLICATIONS - CHEMISTRY

1467 Isotopic Exchange by Electron Transfer between Complex Ions by W B Lewis MIT Laboratory of Nuclear Science and Engineering Technical Report No. 19 (Office of Naval Research Contract) nd 107p (NP-637)

Using Fe^{59} as a tracer for the ferrocyanide-ferricyanide system, and Co^{60} for the four systems containing cobalt the following conclusions were made:

Ferrocyanide, Ferricyanide System: Exchange between ferrocyanide and ferricyanide ions was found to be complete within one minute by three different methods of precipitation of the ferrocyanide ion (Precipitation of lead, silver, and ferric salts of ferrocyanide).

Tris-ethylenediaminecobalt (II), Tris-ethylenediaminecobalt (III) System: The exchange rate between $\left[Co(en)_3\right]^{++}$ and $\left[Co(en)_3\right]^{+++}$ ions was observed to be first order with respect to time and essentially first order with respect to each of these ions at μ = 1.98 and 25°C. No dependence of the exchange rate upon pH or ethylenediamine concentration was detected. The apparent reaction orders at μ = 0.98 and for cobaltous and cobaltic complex concentrations in the range 0.017-0.09 M were

TRACER APPLICATIONS - CHEMISTRY (continued)

substantially less than unity, but the source of error was demonstrated to be the variable ionic composition of the series of experiments. Multivalent cations were shown to have a negative catalytic effect upon the rate at constant ionic strength due to the phenomenon of ionic association. The observations are in qualitative agreement with Bjerrum's theory of ionic association. Using chlorate anion the rate was found to be the same as with chloride. This and other considerations indicate that chloride ion has no specific catalytic effect (salt effect of the secondary type). The exchange rate is independent of the complex in which the radioactive cobalt is incorporated. The free energy, heat, and entropy of formation of the activated complex were determined under several different conditions in accordance with the theory of absolute reaction rates. Using Scatchard's double-sphere activated complex, the above thermodynamic values were interpretated as evidence for an energy of activation, independent of electrostatic interactions, which is required to bring the reactants sufficiently close for the electron to penetrate its potential barrier. The chloride ion catalysis reported for the Fe^{++}, Fe^{+++} and Tl^{+}, Tl^{+++} systems has been interpreted as a secondary salt effect.

Hexamminecobalt (II), Hexamminecobalt (III) System: A lower limit of 80 days was placed upon the half-life for exchange in 5.7 M NH_4OH at 45°C and at $\left[Co(NH_3)_6\right]^{+++} = \left[Co(NH_3)_6\right]^{+++} = 0.0895M$. The slower exchange was attributed to a greater activation energy required to bring the reactants into position for barrier penetration by the electron.

Tris-ethylenediaminecobalt (II), Hexamminecobalt (III) System: The exchange rate was found to be fairly rapid, corresponding to a half-life of 6 min at 25°C at $\left[Co(en)_3\right]^{+++} = \left[Co(MH_3)_6\right]^{+++} = 0.0895M$. The product of exchange was identified as $\left[Co(en)_3\right]Cl_3 \cdot H_2O$. The electron transfer reaction was shown to be the initial and rate-determining step. The rapid exchange rate was interpreted as due to the effect of the net free energy in lowering the free energy of activation.

Hexamminecobalt (II), Tris-ethylenediaminecobalt (III) System: A lower limit of 500 days was placed upon the half-life for exchange in 5.7 M NH_4OH at 45°C at $\left[Co(NH_3)_6\right]^{++} = \left[Co(en)_3\right]^{+++} = 0.0895M$. The relative rates of exchange in this system and the preceding one are due to the respective molar electrode potentials. Hence, this exchange rate should not be observable at 45°C.

1468 Thermal Separation of Radiomercury from Radiosodium by P B Reaser, G E Burch, S A Threefoot and C T Ray Science 109 198 (1949) Feb 25

A practical method for separating radioactive mercury from radioactive sodium by thermal means is described. It was possible to drive off more than 99% of the mercury by heating, whereas under identical circumstances a sodium preparation did not change appreciably. The method should be applicable to the separation of mercury from other elements as well. Further studies are in progress.

TRACER APPLICATIONS - INDUSTRY

1469 Experimental Work Employing Radioisotopes Cobalt and Selenium by Don McCutcheon Non-Destructive Testing 7 No. 3, 7-14 (1948-1949) Winter

The industrial applications of the radioisotopes Se^{75} and Co^{60}, which are γ-emitters, are discussed. The construction of the radioisotope laboratory of the Ford Motor Company is described and some of the possible radiographic applications of radioisotopes are discussed. Several radiographs and absorption curves are shown. 20 figures.

TRANSURANIC ELEMENTS

1470 The Preparation and Decontamination of $_{93}Np^{239}$ in Trace Concentrations by Paul Fields. AECD-2486 (ANL-JJK-14B-66) nd Decl Mar 2 1949 9p For publication in NNES

Np^{239}, an isotope of neptunium emitting beta particles and with a 2.3 day half-life, is formed by the reactions: $U^{238}(n,\gamma)U^{239} \xrightarrow[23m]{\beta} Np^{239}$. Early work, which was performed using the cyclotron as a neutron generator, laid the foundation for the larger scale preparation of Np^{239} using piles as a

TRANSURANIC ELEMENTS (continued)

neutron source. Methods are described for the preparation of pure Np^{239} activity from neutron irradiated uranium compounds. The methods described fall essentially into two classed: (1) co-precipitation methods, and (2) solvent extraction methods.

1471 Alkali Plutonium(IV) Sulfates by Herbert H Anderson. AECD-2489 (ANL-JJK-14B-53) nd Decl Mar 3 1949 8p For publication in NNES

Quadrivalent plutonium precipitates as an alkali plutonium sulfate in the presence of alkali and sulfate ions, the typical formula being $R_4Pu(SO_4)_4 \cdot (1\text{-}2)\ H_2O$. The preparation of double sulfates of plutonium with the alkali ions K^+, NH_4^+, and Rb^+ are described in detail; unsuccessful attempts were made to prepare the double sulfates of plutonium with Li^+, Na^+, and Cs^+.

On the basis of chemical analyses, the following formulae have been assigned with the water of crystallization doubtful in each case: tetra-ammonium plutonium tetrasulfate dihydrate, $(NH_4)_4Pu(SO_4)_4 \cdot 2H_2O$; tetrapotassium plutonium tetrasulfate monhydrate, $K_4Pu(SO_4)_4 \cdot H_2O$ and tetrarubidium plutonium tetrasulfate monohydrate, $Rb_4Pu(SO_4)_4 \cdot H_2O$. X-ray studies have been made of a perfect single crystal of the ammonium derivative, with the conclusion that it is isomorphous with the known cerium analogue $K_4Ce(SO_4)_4 \cdot 2H_2O$, which in turn is believed to be a dihydrate. The exact degree of hydration in this series is a difficult issue, because of the large molecular weights and crystal dimensions. There is no very precise method available for direct determination of water of hydration; formation of basic compounds is a limitation to thermal methods. It is conceivable that the three tetra-alkali salts are all dihydrates.

Considerable differences in solubilities of the double sulfates have been found; potassium forms the least soluble and most easily prepared double sulfate. Isolation of these three double sulfates from solution is an indication of the existence of the complex acid, $H_4Pu(SO_4)_4$, in 0.5M sulfuric acid.

1472 A Study of the Peroxides of Plutonium by J W Hamaker and C W Koch. AECD-2493 (CN-3018) May 17 1945 Decl Mar 3 1949 19p For publication in NNES

Plutonium peroxides were prepared in nitric, sulfuric, and hydrochloric acid solutions. The water-washed solids were dried and analyses were made for sulfate, nitrate, chloride, peroxide, oxygen, hydrogen, and plutonium (PuO_2). The peroxides prepared at room temperature in the presence of sulfuric acid had the range in composition represented by the formula:

$$Pu(O^-)_{2.68\text{-}2.85} \cdot (SO_4^{=})_{0.32\text{-}0.33} \cdot (NO_3^-)_{0.00\text{-}0.04} \cdot (O^{=})_{0.24\text{-}0.34} \cdot 2.06\text{-}2.28H_2O.$$

Two samples prepared in the presence of nitric acid and sulfuric acid, and digested at elevated temperature, contained 3.70 and 3.76 peroxide oxygens per plutonium. Plutonium peroxide nitrates were prepared in the composition range

$$Pu(O^-)_{2.61\text{-}3.52} \cdot (SO_4^{=})_{0.14\text{-}0.005} \cdot (NO_3^-)_{0.06\text{-}0.33} \cdot (O^{=})_{0.06\text{-}0.46} \cdot 1.65\text{-}2.68H_2O.$$

Sulfate is introduced as an impurity in the hydrogen peroxide and is tenaciously held by the plutonium peroxide. Two plutonium peroxide chlorides were prepared:

$Pu(O^-)_{2.24} \cdot (SO_4^{=})_{0.015} \cdot (Cl^-)_{0.47} \cdot (O^{=})_{0.63} \cdot 3.07H_2O$ and $Pu(O^-)_{2.54} \cdot (SO_4^{=})_{0.02} \cdot (Cl^-)_{0.45} \cdot (O^{=})_{0.48} \cdot 2.97H_2O$.

X-ray powder photographs showed two different structures. Thorium peroxide nitrate, plutonium peroxide sulfate (containing 0.04 nitrates per Pu), and plutonium peroxide nitrates (containing 0.02 sulfates per Pu) were isomorphous while plutonium peroxide sulfate (nitrate free), plutonium peroxide nitrate (0.005 SO_4 per Pu) and plutonium peroxide chloride constituted another isomorphous series. An attempt is made to give a structural interpretation of some of the analytical and x-ray results.

TRANSURANIC ELEMENTS (continued)

1473 Half Life of Pu^{238} by Direct Decay Measurement by Arthur H Jaffey. AECD-2494 (ANL-JJK-14B-72) Oct 1946 Decl Mar 3 1949 17p For publication in NNES

Pu^{238} has been previously reported to be an γ-emitter with a 50-year half life (Seaborg et als, Phy Rev 69 366 (1946)). It was thought that this determination, which involved measuring the growth of β-activity from a known amount of Np^{238} β-activity, was subject to errors; therefore the decay of Pu^{238}, produced by the bombardment of U metal with deuterons, was followed over a period of several years by means of an γ-counter. The measurement was somewhat difficult because of the fairly long half-life of Pu^{238} and the presence of γ-emitting Pu^{236} formed by the (d,4n) reaction of U^{238} and subsequent β-disintegration of the Np^{236} formed. The author gives the half-life of Pu^{238} as 89 $\pm$ 9 years. James determined the half-life as being 92 $\pm$ 2 years by extracting and measuring the Pu^{238} formed by the decay of a known amount of Cm^{242}.

1474 Preparation of Some Organic Derivatives of Plutonium by R L Patton. AECD-2500 (ANL-JJK-14B-56) nd Decl Mar 3 1949 3p For publication in NNES

A number of organic reagents known to precipitate thorium have been tested on plutonium by ultramicro techniques. Rough solubility and extractibility characteristics are reported for these organic derivatives. Benzoic acid, oxalic acid, picrolonic and phenylarsonic acids are listed as precipitants of Pu(III). Benzoic, fumaric (pH 4), m-nitrobenzoic (pH 5), salicylic, picrolonic, phenylarsonic, and cinnamic acids, and pyrogallol and 8-hydroxyquinoline are listed as precipitants of Pu(IV).

1475 Preparation and Properties of Americium-242 by L B Asprey and W M Manning. AECD-2505 (ANL-JJK-14B-171) Dec 1948 Decl Mar 9 1949 16p For publication in NNES

In the absence of additional evidence, it was not possible to decide whether Am^{242} was a short-lived beta-emitter decaying to 150-day alpha-emitting Cm^{242}, or whether it was a 150-day beta-emitter decaying to short-lived alpha-emitting Cm^{242}. The purpose of the investigation was (1) to attempt to fix the half-life of the shorter-lived activity, either Am^{242} or Cm^{242}, by bombarding Am^{241} with thermal neutrons for a short period and then quickly observing the growth of Cm^{242} alpha-activity in the sample; (2) having found the approximate half-life for the short-lived activity, to look for a decay of beta-activity with a corresponding half-life. The experiments described show that Am^{242} is in fact the shorter-lived activity (half-life about 16 hours). Consequently the 150-day half-life can be definitely assigned to Cm^{242}. The maximum beta energy for Am^{242} is approximately 1.0 ($\pm$0.3) Mev.

1476 Thermal Neutron Fission Properties of Np^{237} by A Ghiorso, D W Osborne and L B Magnusson. AECD-2509 (ANL-JJK-14B-157) nd Decl Mar 9 1949 4p For publication in NNES

The thermal neutron fission cross section of Np^{237} has been determined to be 0.019×10^{-24} cm^2. Since the fission cross-section of Np^{237} is small compared to that of Pu^{239} and since it is formed as a by-product in chain reacting piles for production of plutonium, careful purification from plutonium was required to reduce the fission rate due to Pu^{239} to a few per cent of that due to Np^{237}. Pa^{238} was used as a tracer to follow the course of purification of Np^{237}.

1477 The Bombardment of Np^{237} with Deuterons and Helium Ions by Ralph A James, Stanley G Thompson and Horace H Hopkins Jr. AECD-2511 (ANL-JJK-14B-136) Oct 1947 Decl Mar 9 1949 7p For publication in NNES

The bombardment of Np^{237} with deuterons has produced Np^{238}, Np^{236}, Pu^{238}, Pu^{236} and a 40-day electron capture plutonium which is probably Pu^{237}. Helium ion bombardment produced some Geiger-Meller activities which may be isotopes of americium.

TRANSURANIC ELEMENTS (continued)

1478 Yields of Plutonium from Cyclotron Neutrons in Various Uranium Containing Media by T P Kohman, A Turkevich, A H Jaffey, C D Coryell, P W Engelkemeir, N Elliott, T B Novey, H S Brown and N R Davidson. AECD-2513 (ANL-JJK-14B-143) July 10 1945 Decl Mar 9 1949 37p For publication in NNES

Measurements have been made of the production of Pu^{239} and of fission activity from cyclotron neutrons at various positions along the axis of columns of uranyl nitrate (N), uranium dioxide (O) and uranium metal (M) in the combinations N, O + N M + N and M + O + N. The activity of U^{239} induced in uranium metal foils and chemically separated was used as a measure of plutonium production, and the activity collected by recoil in cellophane as a measure of fission. Results are presented in tables and graphs and are discussed. The combinations give greater yields of plutonium than N alone. Use of M + N is recommended for prolonged bombardments; a 5-inch layer of M around the cyclotron target does not reduce the yield of Pu^{239} in the N below that which results when N is used alone, and in addition the M acquires in itself a comparable amount of Pu^{239}.

1479 Electronic Structure of the Heaviest Elements by G T Seaborg. AECD-2517 (UCRL-100; ANL-JJK-14B-144) Apr 19 1948 Decl Mar 2 1949 For publication in NNES

All of the available evidence leads to the view that the 5f electron shell is being filled in the heaviest elements giving rise to a transition series which begins with actinium in the same sense that the rare earth or "lanthanide" series begins with lanthanum. Such an "actinide" series is suggested on the basis of evidence in the following lines: (1) chemical properties, (2) absorption spectra in aqueous solution and crystals, (3) crystallographic structure data, (4) magnetic susceptibility data and (5) spectroscopic data. The salient point is that the characteristic oxidation state (i.e., the oxidation state exhibited by the member containing seven 5f and presumably also by the member containing fourteen 5f electrons, curium and element 103) is the III state, and the group is placed in the periodic table on this basis. The data also make it possible to give a suggested table of electronic configurations of the ground state of the gaseous atom for each of the elements from actinium to curium inclusive.

1480 The Tracer Chemistry of Americium and Curium in Aqueous Solutions by S G Thompson, L O Morgan, R A James and I Perlman. AECD-2518 (ANL-JJK-14B-146) May 1948 Decl Mar 9 1949 32p For publication in NNES (See also MDDC-1718 and AECD-1907)

An abstract of this document was assigned the number MDDC-1718 and appeared in Abstracts of Declassified Documents 2 162 (1948) Mar 15. This document is a revision and amplification of AECD-1907 (ANL-JJK-122).

1481 The Separation of Pu(IV) and Pu(III) by A F Voigt, A Kant, N R Sleight, R E Hein, J M Wright, F J Wolter and H D Brown. AECD-2519 (ANL-JJK-14B-65) nd Decl Mar 10 1949 4p For publication in NNES

A method of separating Pu(IV) and Pu(III) by carrying the former on zirconium phenylarsonate precipitates while the latter remains in solution has been studied and found effective and easy to apply. Other methods of accomplishing this separation, principally ones involving extraction of organic complexes, were tried but the separation was incomplete in each case.

1482 The Solubility of Plutonium(IV) Phosphates and the Phosphate Complexes of Plutonium(IV) by Edward L King. AECD-2521 (CN-3360) Oct 12 1945 Decl Mar 14 1949 72p For publication in NNES

The stability of the various complex species of phosphate and plutonium(IV) was determined by the measurement of the solubility of $Pu(HPO_4)_2 \cdot xH_2O$ as a function of the H_3PO_4 concentration at constant nitric acid concentration. The existence of complexes involving from one to five phosphates

TRANSURANIC ELEMENTS (continued)

per plutonium(IV) has been indicated by these measurements. Equilibrium constants for reactions involving the various complex species have been determined.

In connection with the work on the complex ions of plutonium(IV) and phosphate, a study was made of the composition of various solid plutonium(IV) phosphates. A gelatinous solid of the composition: $Pu(HPO_4)_2 \cdot xH_2O$ is precipitated when H_3PO_4 is added to a nitric acid solution of Pu(IV) at room temperature. The existence of two different crystalline plutonium(IV) phosphates of the compositions: $Pu_3(PO_4)_4 \cdot zH_2O$ and $Pu_2H(PO_4)_3 \cdot yH_2O$ has also been shown. These crystalline compounds are formed if the gelatinous $Pu(HPO_4)_2O \cdot xH_2O$ is heated at 110°C in the presence of a HNO_3-H_3PO_4 solution.

1483 The Heat of Formation of Plutonium Tribromide by Edgar F Westrum Jr. AECD-2525 (ANL-JJK-14B-150) nd Decl Mar 14, 1949 6p For publication in NNES

The heat of solution of $PuBr_3$ has been measured in 6.0 molar HCl at 25.00°C as -30.85 ± 0.1 kcal/mole, and the preparation of the compound described. The heat of formation of $PuBr_3$(c) from gaseous bromine and plutonium is calculated as −198.8 kcal/mole; the corresponding value using liquid bromine as the standard state is −187.8 kcal/mole.

1484 The Heat of Formation of Plutonium Trichloride by Edgar F Westrum and Herman P Robinson. AECD-2526 (ANL-JJK-14B-145) May 1948 Decl Mar 14 1949 13p For publication in NNES

The heat of solution of Pu metal and crystalline $PuCl_3$ were determined in 6 molar HCl at 25°C as -141.6 ± 0.2 kcal/mole and -22.15 ± 0.1 kcal/mole, respectively. The heat of formation of $PuCl_3$ was calculated from the elements to be -230.0 ± 0.3 kcal/mole at 25°C.

1485 The Heat of Formation of Plutonium Oxychloride by Edgar F Westrum Jr and Herman P Robinson. AECD-2527 (ANL-JJK-14B-151) nd Decl Mar 14 1949 9p For publication in NNES

The heat of solution of PuOCl in 6 molar hydrochloric acid at 25°C is found to be -24.17 ± 0.1 kcal/mole. The heat of formation of PuOCl is -222.7 ± 0.3 kcal/mole. These data are correlated with other thermodynamic measurements. It appears that the experimental data of other researchers are entirely in accord with present values, but that their treatment of the non-equilibrium data by the method of least squares and estimation of the experimental error on this basis may not be justified.

1486 The Preparation and Properties of Plutonium Oxides by Edgar F Westrum Jr. AECD-2528 (ANL-JJK-14B-154) Dec 1947 Decl Mar 14 1949 15p For publication in NNES

A description of methods and a discussion of techniques applicable to the synthesis and handling of plutonium dioxide on the micro scale is presented. Reductions of PuO_2 to Pu_2O_3-Pu_4O_7 by means of atomic hydrogen, active metals, graphite, and by thermal decomposition in vacuum, and attempted reduction with hydrogen are described. Plutonium monoxide can be conveniently prepared by the thermal reduction of PuOCl with barium. Attempts to prepare an anhydrous oxide richer in oxygen than PuO_2 have been unsuccessful. 30 references

1487 The Heat of Formation of Plutonium Trifluoride by Edgar F Westrum Jr and Leroy Eyring. AECD-2529 (ANL-JJK-14B-152) June 1948 Decl Mar 14 1949 15p For publication in NNES

Measurement of the heat evolved by the precipitation of PuF_3 from 1.5 molar aqueous hydrochloric acid upon addition of aqueous hydrofluoric acid and of the heat of mixing of the two acids yielded a value of -7.2 ± 0.3 kcal/mole for the heat of precipitation of PuF_3 from the solution. Combination of this value with other thermochemical data results in a heat of formation of −375 kcal/mole for the crystalline PuF_3 at 25°C.

URANIUM AND URANIUM COMPOUNDS

1488 Production and Properties of U^{232} and Pa^{232} by J W Gofman and G T Seaborg. AECD-2492 (ANL-HDY-603) Oct 20 1942 Decl Mar 3 1949 6p For publication in NNES

The bombardment of thorium with deuterons in the 60-inch cyclotron produced, in addition to the 27.4-day Pa^{233}, the isotope Pa^{232}, which emits beta-particles and gamma-rays with a half-life of 1.6 days. The 1.6-day Pa^{232} decays to U^{232} which emits alpha-particles and has a half-life of about 30 years. The isotope U^{232}, which is formed in rather good yield, about one microcurie per thousand microampere hours of deuterons, is expected to be useful as a tracer isotope for uranium.

1489 Products of Helium-Ion and Deuteron Bombardment of U^{235} and U^{238} by R A James, A E Florin, H H Hopkins Jr and A Ghiorso. AECD-2495 (ANL-JJK-14B-132) Mar 1948 Decl Mar 3 1949 28p For publication in NNES

In addition to the following isotopes of neptunium and plutonium, Pu^{238}, Pu^{239}, Np^{237}, Np^{238}, and Np^{239}, several more isotopes of these elements have been produced. Np^{236} is a beta-particle emitter with a half-life of 22 hours. Its daughter, Pu^{236}, emits alpha-particles with a range of 4.3 cm (energy 5.7 Mev) and decays with a half-life of 2.7 years. Np^{235} decays by orbital electron capture with a half-life of ca 400 ± 20 days. A plutonium isotope which decays by orbital electron capture with a half-life of 40 days has been assigned the mass number 237. A neptunium isotope (Np^{234} or Np^{233}) has been found which decays by orbital electron capture with a half-life of about 4.5 days; its characteristic x-rays are accompanied by a gamma ray with an energy of 1.8 Mev. U^{237}, Pu^{240}, and Pu^{241} are also produced in these bombardments.

1490 Colorimetric Peroxide Determination of Uranium and its Application to Low Grade Ores by C G Goldbeck and C J Rodden. AECD-2510 nd Decl Mar 9 1949 26p For publication in NNES

A colorimetric method using sodium hydroxide and sodium peroxide for the analysis of uranium in the presence of vanadium has been developed. Interference by vanadium is overcome by heating the solution containing the reagents to the boiling point and then allowing to cool. The method has been applied to Colorado carnotite-bearing sandstone and other low grade uranium-bearing ores after separating the uranium by an ether extraction.

1491 Photometric Determination of Copper, Manganese, Molybdenum, Nickel, Titanium, and Vanadium in Uranium Bearing Materials by G J Petretic and C J Rodden. AECD-2515 nd Decl Mar 9 1949 For publication in NNES

The direct determination of trace elements in the presence of the uranium is desirable since it eliminates the need of a separation of the uranium from the trace element. An application of the monocolor dithizone determination of copper was made resulting in a rapid control procedure for the determination of copper in high grade uranium materials. The application of the permanganate colorimetric procedure to the rapid determination of manganese in uranium metal is possible to within an accuracy of a few parts per million. The thiocyanate-stannous chloride method for the determination of molybdenum has been applied to the analysis of uranium metal and intermediate products. The dimethylglyoxime method for colorimetric determination of nickel has been applied to the analysis of uranium samples; investigation of various oxidants was made and, of these, persulfate was found to be satisfactory. Titanium was found to be completely separated from the uranium by a cupferron separation. The extent of the interference due to molybdenum and vanadium was investigated, and it was shown that titanium in uranium metal can easily be determined in their presence. An application of the peroxide colorimetric determination of titanium was made, making possible a rapid determination of the titanium content of uranium metal. The colorimetric determination of vanadium using hydrogen peroxide was successfully applied to the analysis of uranium compounds and uranium bearing materials. 17 references.

URANIUM AND URANIUM COMPOUNDS (continued)

1492 Uranium Trifluoride — A Summary Report by J C Warf. AECD-2523 nd Mar 10 1949 9p (See also AECD-2413)

A short history of attempts to prepare uranium trifluoride is given. It was shown that uranium tetrafluoride is not reduced by hydrogen, and that treatment of uranium trichloride or tribromide with hydrogen fluoride also fails to give uranium trifluoride. Other investigators have reported that some uranium trifluoride can be prepared by reduction of the tetrafluoride with atomic hydrogen. The most convenient method of producing the trifluoride, however, is by the reduction of green salt with uranium from uranium hydride, in nickel vessels at about 1100°C. The product thus formed is a black, coke-like solid, and is identified by analysis and x-ray studies. A resume of the physical and chemical properties of the trifluoride is given, as well as a discussion of the x-ray diffraction studies. This document summarizes the information found in AECD-2413.

1493 The Purification of Uranium by Bertrand Goldschmidt Atomes 4 52-53 (1949) Feb (In French)

Briefly the method used for obtaining uranium compounds pure enough for use in the French pile consisted of the extraction of $UO_2(NO_3)_2$ with ethyl ether, precipiting the $UO_2(NO_3)_2$ as UO_4 with H_2O_2, converting the UO_4 to UO_3 with heat, and reducing the UO_3 to UO_2 in a stream of hydrogen. By this procedure strong neutron absorbers such as B, Cd, Li, and certain of the rare earths were eliminated.

VACUUM SYSTEMS

1494 A Philips Type Ionization Gauge for Measurement of Vacuum From 10^{-7} mm to 10^{-1} mm of Mercury by E C Evans. AECU-145 (K-341) Feb 11 1949 26p

A Philips (Penning) Type Ionization Gauge is described which is capable of measuring vacuum down to 10^{-7} mm. of Hg. Construction and operation details of the gauge are given in addition to its advantages and disadvantages as compared to hot cathode type ionization gauges. In most applications where a hot cathode ionization gauge is used alone or in conjunction with a thermocouple or Pirani vacuum gauge, the advantages of using a Philips ionization gauge are shown to outweigh the disadvantages. The Philips gauge may be used satisfactorily in the pressure range from 10^{-7} to 10^{-1} mm. of mercury. Drawings, a method of operating the Philips ion gauge when used on a mass spectrometer, calibration curves, theory of operation, and factors affecting the operation are included.

1495 Conductance of Bends and Concentric Tubes of a Vacuum System by E V Sherriff J Sci Instruments 26 43-45 (1949) Feb

Conductances in a vacuum system of right-angle bends and manifolds constructed of 2 concentric tubes were measured. The effect of a right-angle bend on the conductance of a tube can be represented by an additional tube length of one tube diameter. The conductance of a long regular annular space is given by a modified form of Knudsen's equation:

$$S = \frac{4\sqrt{(2\pi)}}{3}\left[\frac{(r_2^2 - r_1^2)(r_2 - r_1)}{L}\right]\frac{I}{\sqrt{\rho_1}}$$

1496 High Vacua in Nuclear Physics and Atomic Energy by M L E Oliphant Chem and Ind (London) No. 6,88 (1949) Feb 5

This is a brief account of a paper read by the author at the High Vacua Convention, Gleneagles, October 12-13, 1948. A survey is given of the special vacuum problems which confront the nuclear physicist, and of the practical solutions given to problems regarding appropriate gasket joints, valves, pressure gages, the use of the mass spectrometer in leak detection, the permeability of materials to gases and the back diffusion of oil vapor in oil pumps.

ATOMIC ENERGY COMMISSION

Declassified Documents Published in Periodicals

AEC declassified documents published in scientific and technical journals through December 1948 are listed below. Documents published since December 1948 are listed in each issue of Nuclear Science Abstracts. Cumulated supplementary lists will appear in future index volumes of Nuclear Science Abstracts.

Abstracts of documents up to AECD - 2023 are found in Abstracts of Declassified Documents; AECD - 2024 and beyond, in Nuclear Science Abstracts. (Note: MDDC refers to documents 1 through 1779; AECD, to 1780 on.)

MDDC	Published in
4	Phys Rev 70 136-153 (1946) Aug
5	J Applied Phys 18 30-33 (1947) Jan
6	Phys Rev 70 583-589 (1946) Nov
8	Phys Rev 70 245-248 (1946) Sept
9	Phys Rev 70 458-459 (1946) Oct
10	Phys Rev 71 565-567 (1947) May 1
11	Phys Rev 73 956-962 (1948) May 1
12	The New American Library of World Literature, Inc, New York (formerly Penguin Books, Inc, New York)
13	Phys Rev 70 249-258 (1946) Sept
17	J Phys and Colloid Chem 51 611-625 (1947) Mar
20	J Applied Phys 17 447-449 (1946) June
21	J Applied Phys 17 444-447 (1946) June
22	Phys Rev 70 429 (1946) Sept
24	Phys Rev 71 1-3 (1947) Jan 1
25	Phys Rev 70 89 (1946) July
29	J Amer Chem Soc 68 2367-2372 (1946) Nov
30	J Amer Chem Soc 68 2373-2377 (1946) Nov
31	Rev Sci Instruments 18 643-646 (1947) Sept
32	Phys Rev 72 196-202 (1947) Aug 1
36	Science 105 265-267 (1947) Mar 7
37	Phys Rev 70 805-807 (1946) Dec
41	Phys Rev 69 669-670 (1946) June
43	Phys Rev 70 87 (1946) July
44	Rev Sci Instruments 17 301-306 (1946) Aug
47	J Chem Education 23 583-541 (1946) Nov
50	Science 104 91-96 (1946) Aug 2
51	Phys Rev 70 589-592 (1946) Nov
52	J Applied Phys 18 34-48 (1947) Jan
53	Analyt Chem 20 188-194 (1948) Mar
54	Phys Rev 70 815-817 (1946) Dec
59	Revs Modern Physics 19 259-297 (1947) Oct
61	Phys Rev 71 745-747 (1947) June 1
80	Rev Sci Instruments 18 884-893 (1947) Dec
88	J Chem Phys 14 569 (1946) Sept
90	Science 104 156-160 (1946) Aug 16; J Research Natl Bur Standards 38 137-168 (1947) Feb
93	Phys Rev 70 580-582 (1946) Nov
97	Metals Technol 14 Tech Pub 2152 (1947) Apr 5p
98	J Amer Chem Soc 68 2117 (1946) Oct
100	Phys Rev 70 431 (1946) Sept
115	Phys Rev 73 207-215 (1948) Feb 1
123	Phys Rev 70 602-605 (1946) Nov
124	Phys Rev 71 210-211 (1947) Feb 1
125	Phys Rev 69 666 (1946) June
134	Phys Rev 70 808-811 (1946) Dec

MDDC	Published in
140	Phys Rev 70 232 (1946) Aug
141	Phys Rev 70 640-642 (1946) Nov
145	Radiology 49 361-363 (1947) Sept
152	Chem Eng Progress 44 315-326 (1948) Apr
154	Ind and Eng Chem 39 281-283 (1947) Mar
168	Analyt Chem 19 148-149 (1947) Mar 25
170	Analyt Chem 19 146-147 (1947) Mar 25
171	Phys Rev 69 666 (1946) June
183	Rev Sci Instruments 18 86-89 (1947) Feb
189	Phys Rev 71 272 (1947) Feb 15
196	Analyt Chem 19 150-153 (1947) Mar 25
198	Rev Sci Instruments 18 294-297 (1947) May
200	Phys Rev 70 434-435 (1946) Sept
201	Phys Rev 72 203-206 (1947) Aug 1
202	Ind and Eng Chem 39 314-319 (1947) Mar
205	Phys Rev 70 592-596 (1946) Nov
218	Ind and Eng Chem 39 384-386 (1947) Mar
227	Science 104 379-386 (1946); Nature 159 863-865 (1947) June 28
231	Phys Rev 70 557-558 (1946) Oct
232	Phys Rev 72 729 (1947) Oct 15
234	Analyt Chem 19 222-224 (1947) Apr
256	Phys Rev 71 508-510 (1947) Apr 15
259	Radiology 49 349-359 (1947) Sept
262	Chem and Eng News 24 3168-3173 (1946) Dec 10
280	J Amer Chem Soc 69 2500-2502 (1947) Oct
281	Phys Rev 70 569 (1946) Oct; Phys Rev 74 728-735 (1948) Oct 1
283	Ind and Eng Chem 39 259-262 (1947) Mar
284	Phys Rev 71 327-330 (1947) Mar 15
289	Chem and Eng News 24 2906-2909 (1946) Nov
291	Rev Sci Instruments 19 28-30 (1948) Jan
292	Phys Rev 71 826 (1947) June 1
305	J Amer Chem Soc 70 1571-1573 (1948) Apr
307	Phys Rev 70 561 (1946) Dec
313	Ind and Eng Chem 39 286-288 (1947) Mar
315	Phys Rev 71 497-507 (1947) Apr 15
326	Blood 3 593-611 (1948) May
327	Phys Rev 72 109-115 (1947) July 15
328	Ind and Eng Chem 39 244-248 (1947) Mar
333	Phys Rev 71 911 (1947) June 15
334	Phys Rev 70 766 (1946) Nov; Phys Rev 71 878-886 (1947) June 15
340	Analyt Chem 20 282 (1948) Mar
345	J Optical Soc Amerc 37 279-288 (1947) Apr
347	Ind and Eng Chem 39 367-374 (1947) Mar
348	Phys Rev 73 852-862 (1948) Apr 15
349	Phys Rev 70 555-556 (1946) Oct
352	Phys Rev 71 14-19 (1947) Jan 1
355	Analyt Chem 19 824-827 (1947) Nov
359	Phys Rev 72 1147-1156 (1947) Dec 15
368	J Chem Phys 16 429-436 (1948) May
380	J Research Natl Bur Standards 39 397-409 (1947) Nov
381	Phys Rev 70 768 (1946) Nov
386	Phys Rev 70 982-983 (1946) Dec
394	Phys Rev 72 88 (1947) July 1
399	Phys Rev 72 47-50 (1947) July 1
400	Phys Rev 70 983 (1946) Dec
402	Chem and Eng News 24 3032-3034 (1946) Nov 25
404	Phys Rev 70 779 (1946) Nov
405	Phys Rev 71 65-79 (1947) Jan 15
407	J Research Natl Bur Standards 37 379-389 (1946) Dec
408	Phys Rev 72 888-901 (1947) Nov 15
409	Rev Sci Instruments 18 278-288 (1947) May

MDDC	Published in
410	J Amer Chem Soc 69 2777-2780 (1947) Nov
411	J Amer Chem Soc 69 2786-2792 (1947) Nov
412	J Chem Phys 15 440-446 (1947) July
416	Phys Rev 71 140 (1947) Jan 15 (abstract of MDDC — 515, which see)
421	Phys Rev 71 144 (1947) Jan 15; Phys Rev 71 829 (1947) June 1
424	Phys Rev 71 372 (1947) Mar 15 (abstract of MDDC — 774, which see)
428	Phys Rev 71 144 (1947) Jan 15 (abstract of MDDC — 465 and MDDC — 466, which see)
431	Ind and Eng Chem 39 401-404 (1947) Mar
433	Ind and Eng Chem 39 333-337 (1947) Mar
440	Revs Modern Physics 18 513-544 (1946) Oct; J Amer Chem Soc 68 2411-2442 (1946) Nov (see MDDC — 456 for revision)
449	Phys Rev 70 766 (1946) Nov
450	Anat Record 98 19-24 (1947) May
451	Phys Rev 72 875-880 (1947) Nov 15
452	Phys Rev 72 881-888 (1947) Nov 15
453	Phys Rev 71 567-572 (1947) May 1
455	Amer J Roentgenol and Radium Therapy 58 10-16 (1947) July
457	J Research Natl Bur Standards 39 53-58 (1947) July
459	Part I. Chem Eng 54 127-131 (1947) Nov; Part II. Chem Eng 54 122-124 (1947) Dec
463	Phys Rev 71 294-310 (1947) Mar 1
464	Phys Rev 71 165-173 (1947) Feb
465	Phys Rev 71 130 (1947) Jan 15
466	Phys Rev 71 270 (1947) Feb 15
476	Phys Rev 71 582-585 (1947) May 1
477	Phys Rev 70 778 (1946) Nov
479	Proc Natl Acad Sci US 32 302-306 (1946) Dec
480	Phys Rev 71 174-181 (1947) Feb 1
488	Radiology 49 344-347 (1947) Sept
489	Phys Rev 71 529-530 (1947) Apr 15
499	Radiology 49 314-324 (1947) Sept
505	Chem and Eng News 25 358-360 (1947) Feb 10
507	Analyt Chem 19 193-196 (1947) Mar 25
515	Phys Rev 71 573-581 (1947) May 1
516	Science 105 45 (1947) Jan 10
519	Phys Rev 71 122 (1947) Jan 15
528	J Optical Soc Amerc 37 93-98 (1947) Feb
530	Science 105 208 (1947) Feb 21
531	Phys Rev 71 409-412 (1947) Apr 1
536	Occupational Med 2 1-7 (1946) July
547	J Chem Phys 15 544-551 (1947) Aug
551	Amer J Roentgenol and Radium Therapy 58 357-358 (1947) Sept
553	Phys Rev 72 567-569 (1947) Oct 1
559	Phys Rev 71 560 (1947) Apr 15
560	Phys Rev 72 189-192 (1947) Aug 1
561	Phys Rev 72 98-100 (1947) July 15
571	Amer J Botany 34 415-420 (1947) Oct
585	Radiology 49 271-273 (1947) Sept
592	J Chem Education 24 115-120 (1947) Mar
595	Science 105 389-390 (1947) Apr
600	Ind and Eng Chem 39 319-329 (1947) Mar
611	Radiology 49 299-313 (1947) Sept (see MDDC — 1066 for supplement)
612	J Phys and Colloid Chem 52 340-350 (1948) Feb
613	Phys Rev 72 888-901 (1947) Nov 15
617	Phys Rev 71 372-373 (1947) Mar 15
618	Phys Rev 71 373-374 (1947) Mar 15
620	J Amer Chem Soc 69 1389-1391 (1947) June
625	Phys Rev 71 457 (1947) Apr 1
628	J Amer Chem Soc 69 1529-1531 (1947) June

MDDC	Published in
629	Phys Rev 71 752-757 (1947) June 1
635	Ind and Eng Chem 39 266-272 (1947) Mar
638	Federation Proc 6 No. I Part II 245 (1947)
659	Abstracts of the American Chemical Society Meeting 44P (1947) Apr 14-18
669	Phys Rev 72 16-23 (1947) July 1
670	Phys Rev 72 662-672 (1947) Oct 15
671	Phys Rev 71 552 (1947) Apr 15
672	Phys Rev 71 643 (1947) May 1
673	Phys Rev 71 561-562 (1947) Apr 15
675	Phys Rev 73 1181-1187 (1948) May 15
676	Phys Rev 72 29-41 (1947) July 1
693	Phys Rev 71 832 (1947) June 1
703	J Chem Phys 15 208-209 (1947) Apr
704	Rev Sci Instruments 18 186-188 (1947) Mar
706	Phys Rev 71 453 (1947) Apr 1
707	J Chem Phys 15 261-267 (1947) May
708	J Amer Chem Soc 69 2818-2829 (1947) Nov
709	J Research Natl Bur Standards 38 129-135 (1947) Jan
710	Phys Rev 71 449-450 (1947) Apr 1
711	Phys Rev 71 378 (1947) Mar 15
712	Federation Proc 6 No. I Part II 319 (1947)
713	Phys Rev 71 666-677 (1947) May 15
718	Rev Sci Instruments 18 703-705 (1947) Oct
719	J Biol Chem 171 273-283 (1947) Nov
726	Science 105 265 (1947) Mar 7
733	Phys Rev 71 454 (1947) Apr 1
735	Phys Rev 71 757-776 (1947) June 1
736	Phys Rev 71 556-557 (1947) Apr 15
738	Phys Rev 71 887-890 (1947) June 15
742	Rev Sci Instruments 18 556-558 (1947) Aug
750	Physiol Zool 20 405-421 (1947) Oct
762	Phys Rev 71 321 (1947) Mar 1
765	Genetics 33 43-74 (1948) Jan
769	Analyt Chem 19 828-832 (1947) Nov
771	Phys Rev 72 193-196 (1947) Aug 1
773	Rev Sci Instruments 18 706-715 (1947) Oct
774	Phys Rev 71 372 (1947) Mar 15
779	Phys Rev 71 743 (1947) May 15
786	Phys Rev 72 91-98 (1947) July 15
787	Phys Rev 71 378 (1947) Mar 15
788	Rev Sci Instruments 18 540-545 (1947) Aug
791	Rev Sci Instruments 18 639-643 (1947) Sept
793	J Chem Phys 15 374-375 (1947) June
797	Phys Rev 72 167-168 (1947) July 15 (abstract of MDDC — 953, which see)
807	Phys Rev 72 168 (1947) July 15
812	Phys Rev 74 631-638 (1948) Sept 15
823	Phys Rev 72 169 (1947) July 15
837	J Chem Phys 15 703-712 (1947) Oct
842	Phys Rev 73 842-847 (1948) Apr 15
844	Phys Rev 72 408-410 (1947) Sept 1
845	Phys Rev 72 907-913 (1947) Nov 15
849	Phys Rev 73 1277-1290 (1948) June 1 (published with MDDC — 873)
853	Radiology 51 400-413 (1948) Sept
865	J Amer Chem Soc 69 1719-1723 (1947) July
866	Phys Rev 72 312-320 (1947) Aug 15
867	Phys Rev 69 366-367 (1946) Apr
873	Phys Rev 73 1277-1290 (1948) June 1 (published with MDDC — 849)
874	Phys Rev 71 907 (1947) June 15

MDDC	Published in
875	Phys Rev 72 447-451 (1947) Sept 15
876	Phys Rev 72 445-446 (1947) Sept 15
877	Rev Sci Instruments 18 693-695 (1947) Oct
907	J Natl Cancer Inst 6 349-353 (1946) June; Cancer Research 6 485-486 (1946) Sept
909	Chem Eng 54 122-125 (1947) Oct
931	Phys Rev 72 1003-1007 (1947) Dec 1
933	Phys Rev 72 649-661 (1947) Oct 15
936	Amer J Ophthmol 31 137-154 (1948) Feb
937	Chem and Eng News 25 3794-3798 (1947) Dec 22 (includes photographs declassified as MDDC—1382); J Ind Hyg Toxicol 30 286-293 (1948) Sept
938	Phys Rev 72 349 (1947) Aug 15
939	Phys Rev 7 541-544 (1947) Oct 1
940	Phys Rev 7 545-549 (1947) Oct 1
946	Phys Rev 72 926-930 (1947) Nov 15
957	Phys Rev 72 82 (1947) July 1
958	J Phys and Colloid Chem 52 350-357 (1948) Feb
965	Science 105 664-665 (1947) June 27
966	J Biol Chem 169 459-460 (1947) July
968	Phys Rev 72 585-590 (1947) Oct 1
969	Phys Rev 73 830-841 (1948) Apr 15
972	Phys Rev 72 673-677 (1947) Oct 15
974	Rev Sci Instruments 18 682-683 (1947) Sept
975	Phys Rev 72 248 (1947) Aug 1
976	Phys Rev 72 435 (1947) Sept 1
977	J Amer Chem Soc 70 1037-1039 (1948) Mar
978	Phys Rev 72 85 (1947) July 1
979	Amer J Physiol 150 480-487 (1947) Sept
985	Analyt Chem 20 458-460 (1948) May
1006	Soil Sci 65 129-134 (1948) Feb
1013	Phys Rev 72 739 (1947) Oct 15
1020	Phys Rev 72 739 (1947) Oct 15
1026	J Amer Chem Soc 69 2879-2881 (1947) Nov
1029	Phys Rev 72 680-681 (1947) Oct 15
1031	Analyt Chem 20 233-235 (1948) Mar
1033	Rev Sci Instruments 18 821-830 (1947) Nov
1042	Phys Rev 72 349 (1947) Aug 15
1043	Phys Rev 72 352-353 (1947) Aug 15
1045	Rev Sci Instruments 18 900-907 (1947) Dec
1046	Phys Rev 72 591-593 (1947) Oct 1
1047	J Biol Chem 173 207-209 (1948) Mar
1048	Phys Rev 72 352 (1947) Aug 15
1049	Phys Rev 72 749-757 (1947) Nov 1
1050	Phys Rev 73 271-273 (1948) Feb 15
1053	Phys Rev 72 766-771 (1947) Nov 1
1056	J Phys and Colloid Chem 52 479-490 (1948) Mar
1064	Revs Modern Physics 19 185-238 (1947) July
1066	Radiology 49 299-313 (1947) Sept (supplement to MDDC-611)
1068	Phys Rev 72 758-765 (1947) Nov 1
1075	J Amer Chem Soc 69 2836-2848 (1947) Nov
1078	Metal Progress 52 387-390 (1947) Sept
1079	Rev Sci Instruments 18 796 (1947) Oct
1082	Phys Rev 72 902-907 (1947) Nov 15
1083	Phys Rev 73 111-124 (1948) Jan 15
1084	Phys Rev 72 967-970 (1947) Nov 15

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1085	Phys Rev 72 732-733 (1947) Oct 15
1091	J Chem Phys 15 875-879 (1947) Dec
1093	J Amer Chem Soc 69 2812-2818 (1947) Nov
1096	J Research Natl Bur Standards 39 317-320 (1947) Oct
1097	Phys Rev 74 991-1000 (1948) Nov 1
1102	J Lab and Clin Med 32 1045-1059 (1947) Sept
1104	Econometrica 15 314-334 (1947) Oct; Bull Atomic Scient 4 115-121 (1948) Apr
1113	J Amer Chem Soc 69 2849-2859 (1947) Nov
1115	Phys Rev 71 380-381 (1947) Mar 15
1119	Phys Rev 72 730 (1947) Oct 15
1120	Phys Rev 72 646-647 (1947) Oct 1
1121	Phys Rev 72 515-516 (1947) Sept 15
1122	Chem and Eng News 25 2624-2625 (1947) Sept 15
1124	Phys Rev 73 347-349 (1948) Feb 15
1125	Phys Rev 72 7-15 (1947) July 1
1158	Science 106 245-246 (1947) Sept 12
1160	Radiology 49 325-343 (1947) Sept
1164	J Amer Chem Soc 69 2800-2812 (1947) Nov
1167	J Biol Chem 172 185-190 (1948) Jan
1168	J Amer Chem Soc 70 3499-3502 (1948) Oct
1169	Phys Rev 72 1049-1053 (1947) Dec 1
1181	J Chem Phys 16 442-445 (1948) May
1183	Phys Rev 72 1139-1146 (1947) Dec 15
1184	Phys Rev 71 589-594 (1947) May 1
1186	Phys Rev 72 252 (1947) Aug 1
1187	Phys Rev 72 634-636 (1947) Oct 1
1189	Phys Rev 73 184-185 (1948) Jan 15
1193	Rev Sci Instruments 18 897-899 (1947) Dec
1194	Phys Rev 73 1318-1330 (1948) June 1
1195	Phys Rev 74 991-1000 (1948) Nov 1
1200	Genetics 33 75-95 (1948) Jan
1208	Analyt Chem 20 571-572 (1948) June
1216	J Amer Chem Soc 69 2781-2785 (1947) Nov
1225	J Amer Chem Soc 69 2859-2865 (1947) Nov
1227	Phys Rev 73 1-6 (1948) Jan 1
1228	Physica 14 17-28 (1948) Jan
1229	Phys Rev 72 973 (1947) Nov 15
1230	Rev Sci Instruments 19 83-84 (1948) Feb
1231	Phys Rev 73 106-110 (1948) Jan 15
1236	Phys Rev 72 972 (1947) Nov 15
1237	Arch Path 45 354-359 (1948) Mar
1238	Phys Rev 72 1008-1016 (1947) Dec 1
1239	Science 107 115-118 (1948) Jan 30
1291	Phys Rev 72 986-987 (1947) Nov 15
1295	J Chem Phys 16 436-441 (1948) May
1296	Rev Sci Instruments 19 116 (1948) Feb
1298	Phys Rev 73 1119 (1948) May 1
1299	Phys Rev 72 866-867 (1947) Nov 1
1302	Chem Eng 55 117 (1948) Jan
1303	Rev Sci Instruments 19 667-674 (1948) Oct
1306	Phys Rev 72 873-874 (1947) Nov 1
1309	Radiology 51 719-727 (1948) Nov
1312	Phys Rev 73 424-436 (1948) Mar 1
1313	Phys Rev 73 279-284 (1948) Feb 15
1320	Phys Rev 72 872-873 (1947) Nov 1
1321	J Biol Chem 173 205-206 (1948) Mar
1322	J Amer Chem Soc 70 1207-1209 (1948) Mar
1324	Phys Rev 72 1127-1128 (1947) Dec 1

MDDC	Published in
1348	Phys Rev 73 815-821 (1948) Apr 15
1352	Phys Rev 73 1463-1466 (1948) June 15
1353	Phys Rev 73 1135-1139 (1948) May 15
1354	Phys Rev 72 1254-1255 (1947) Dec 15
1356	J Chem Phys 16 141-147 (1948) Feb
1357	Phys Rev 72 1114-1115 (1947) Dec 1
1382	Chem and Eng News 25 3794-3798 (1947) Dec 22 (photographs; includes MDDC—937)
1399	Phys Rev 72 1264-1265 (1947) Dec 15
1400	Phys Rev 72 1271-1272 (1947) Dec 15
1401	Phys Rev 73 187-188 (1948) Jan 15
1404	J Biol Chem 174 427-437 (1948) June
1403	Phys Rev 73 350-360 (1948) Feb 15
1410	Phys Rev 73 533 (1948) Mar 1
1411	Phys Rev 73 533-534 (1948) Mar 1
1416	Growth 12 107-121 (1948) June
1418-C	Cancer Research 7 721 (1947) Nov
1419	Phys Rev 74 505 (1948) Aug 15
1421	Phys Rev 73 541 (1948) Mar 1
1422	Phys Rev 73 180 (1948) Jan 15
1423-A	Genetics 33 112-113 (1948) Jan
1423-B	Genetics 33 113 (1948) Jan
1425	Phys Rev 73 80-81 (1948) Jan
1426	Phys Rev 73 185 (1948) Jan 15
1427	J Amer Chem Soc 69 2866-2874 (1947) Nov
1429	Phys Rev 72 1269-1270 (1947) Dec 15; Phys Rev 73 653 (1948) Mar 15; Acta Cryst 1 161-162 (1948) Sept
1430	Phys Rev 72 1270 (1947) Dec 15
1431	Phys Rev 73 545-549 (1948) Mar 15
1433	Science 107 47 (1948) Nan 9
1441	Phys Rev 73 540-541 (1948) Mar 1
1443	Science 106 506 (1947) Nov 28
1444	Phys Rev 73 535 (1948) Mar 1
1445	Phys Rev 73 534-535 (1948) Mar 1
1446	Phys Rev 73 540 (1948) Mar 1
1450	Radiology 50 811-834 (1948) June
1451	Phys Rev 73 534 (1948) Mar 1
1457	J Amer Chem Soc 69 2792-2800 (1947) Nov
1458	Phys Rev 73 264-265 (1948) Feb 1
1459	Phys Rev 73 541 (1948) Mar 1
1460	Phys Rev 72 1269-1270 (1947) Dec 15
1461	Phys Rev 73 822-830 (1948) Apr 15
1463	Phys Rev 73 262-263 (1948) Feb 1
1464	Rev Sci Instruments 19 396-398 (1948) June
1467	Phys Rev 73 535 (1948) Mar 1
1468	Phys Rev 73 733-741 (1948) Apr 1
1470	Phys Rev 73 535 (1948) Mar 1
1482	J Amer Chem Soc 69 2769-2776 (1947) Nov
1483	Phys Rev 73 742-749 (1948) Apr 1
1485	Nature 160 801-803 (1947) Dec 6 (summary of MDDC—1485, MDDC—1486, and MDDC—1487)
1486	Nature 160 801-803 (1947) Dec 6 (summary of MDDC—1485, MDDC—1486, and MDDC—1487); Science 107 253-254 (1948) Mar 5
1487	Nature 160 801-803 (1947) Dec 6 (summary of MDDC—1485, MDDC—1486, and MDDC—1487)
1489	J Applied Phys 19 639-641 (1948) July
1509	J Amer Chem Soc 70 2418-2420 (1948) July
1512	J Optical Soc Amerc 38 666 (1948) July
1513	J Amer Chem Soc 70 442 (1948) Jan
1516	Phys Rev 73 809-810 (1948) Apr 1
1521	Phys Rev 73 762-774 (1948) Apr 1
1532	Phys Rev 73 265-266 (1948) Feb 1
1536	Phys Rev 73 1307-1310 (1948) June 1

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MDDC	Published in
1546	Phys Rev 74 650-655 (1948) Sept 15
1557	Phys Rev 73 540 (1948) Mar 1; Bull Amer Phys Soc 23 14 (1948) Jan 2
1560	Rev Sci Instruments 19 506-512 (1948) Aug
1567	Phys Rev 74 591-560 (1948) Sept 1
1571	J Chem Phys 16 513-519 (1948) May
1572	Phys Rev 73 1104-1105 (1948) May 1
1573	J Chem Phys 16 254 (1948) Mar
1575	J Chem Phys 16 797-807 (1948) Aug
1582	Phys Rev 73 806 (1948) Apr 1
1595	Phys Rev 73 529 (1948) Mar 1
1607	Phys Rev 72 570-575 (1947) Oct 1
1608	J Amer Chem Soc 70 99-104 (1948) Jan
1627	Phys Rev 73 630 (1948) Mar 15
1642	Phys Rev 73 813 (1948) Apr 1
1643	Analyt Chem 20 498-503 (1948) June
1645	Phys Rev 73 963-972 (1948) May 1
1656	Nucleonics 3 21-26 (1948) July
1660	J Amer Chem Soc 70 3453-3454 (1948) Oct
1668	Phys Rev 73 811-812 (1948) Apr 1
1669	Phys Rev 73 527-528 (1948) Mar 1
1675	J Chem Phys 16 425 (1948) Apr
1679	Phys Rev 74 150-152 (1948) July 15
1684	Phys Rev 73 919 (1948) Apr 15
1686	Phys Rev 74 423-432 (1948) Aug 15
1687	Phys Rev 74 773-778 (1948) Oct 1
1688	J Amer Chem Soc 70 1671-1672 (1948) Apr
1689	Growth 12 203-242 (1948) Sept
1691	J Research Natl Bur Standards 38 185-189 (1947) Feb
1701	J Amer Chem Soc 70 2235-2240 (1948) June
1740	Phys Rev 74 98-99 (1948) July 1
1745-E	Phys Rev 72 1160-1164 (1947) Dec 15
1745-F	Phys Rev 72 1260-1261 (1947) Dec 15
1745-G	Phys Rev 72 1160-1164 (1947) Dec 15
1759	Phys Rev 73 1124-1125 (1948) May 1
1767	J Amer Chem Soc 70 3450-3452 (1948) Oct

AECD	Published in
1783	Phys Rev 73 1127-1128 (1948) May 1
1785	J Biol Chem 175 691-703 (1948) Sept
1786	Phys Rev 73 1214-1215 (1948) May 15
1806	Chem and Eng News 26 740-741 (1948) Mar 15
1809	Phys Rev 73 1125-1126 (1948) May 1
1813	Phys Rev 73 1211 (1948) May 15
1817	Phys Rev 74 104-105 (1948) July 1
1818	Phys Rev 74 235-239 (1948) Aug 1
1820	Phys Rev 74 373-385 (1948) Aug 15
1825	Phys Rev 73 1114-1115 (1948) May 1
1829	J Amer Chem Soc 70 1128-1134 (1948) Mar
1830	Phys Rev 73 940-941 (1948) May 1
1837	Phys Rev 74 264-267 (1948) Aug 1
1838	Phys Rev 73 1406-1407 (1948) June 1
1839	Phys Rev 73 1202-1203 (1948) May 15
1844	Phys Rev 73 1411-1412 (1948) June 1
1854	Phys Rev 73 1405-1406 (1948) June 1
1855	Phys Rev 73 1404-1405 (1948) June 1
1863	J Chem Phys 16 1077-1081 (1948) Nov